

# Control Science Evolution

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Proceedings of the Second  
Convegno Internazionale sui Problemi dell'Automatismo

50<sup>th</sup> Anniversary of Control Science in Italy

*Sergio Bittanti ed.*



CONSIGLIO NAZIONALE DELLE RICERCHE

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1956

2006

2056



CONSIGLIO NAZIONALE DELLE RICERCHE

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## Editor's Foreword

*This book contains the set of lectures given at the Second “Convegno Internazionale sui Problemi dell’Automatismo” (International Conference on Automatica Problems), held at the Politecnico di Milano, Milan, Italy, on September the 18<sup>th</sup>, 2006. This meeting took place 50 years after the first memorable Convegno of 1956 which is widely considered as one the most significant early events in the area of automatic control in the XXth Century as well as the big bang of modern Control Science in Italy.*

*The Volume is organized in three parts.*

*The First Part contains the messages from the authorities and the welcome addresses. The messages were from the Presidency of the Italian Republic, the President of Regione Lombardia (Lombardy Region) and the President of the National Research Council of Italy (CNR - Consiglio Nazionale delle Ricerche). The welcome addresses were given by Giulio Ballio, Rector Magnificus of the Politecnico di Milano, Francesco Beltrame, Director of the Information and Communication Technology Department of the CNR, and by the Professors of the Politecnico di Milano Sergio Carrà and Emilio Gatti. The addresses by Francesco Beltrame, Sergio Carrà and Emilio Gatti were given on behalf of the President of CNR, the President of the Accademia Nazionale dei Lincei (The National Academy of the Lynxes) and the President of Istituto Lombardo Accademia di Scienze e Lettere (Lombardy Institute – Academy of Sciences and Letters) respectively.*

*An essay, by Sergio Bittanti, chairperson and professor at the Politecnico di Milano, follows after the welcome address. The essay recollects and predicts the evolution of Control Science over a century spanning from 1956 to 2056. The starting event is the Convegno Internazionale sui Problemi dell’Automatismo organized by the CNR in 1956. The Convegno had the twofold purpose of gathering the best experts in the rising discipline of automatic control and to present to the general public the potential of the new discipline. At the time of the Convegno, automatic control ideas attracted a large interest in the general population and people had high expectations from it. For these reasons the event consisted of a scientific Congress accompanied by an exhibition for the general public, both taking place at the Museo della Scienza e della Tecnologia (Museum of Science and Technology) of Milan. In the essay, attention is not only paid to the events which took place in Italy, but also to the scientists and engineers who contributed to the growth of the discipline both in academia and industry. The paper is followed by two appendices. The first one is a reproduction of the opening speech given by Gustavo Colonnetti at the Convegno of 1956 in his role of President of the CNR. The second is a recollection of memoirs by Peter Kokotovic on Giorgio Quazza, one of the master nav-*

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igators in the world of control. This recollection is a transcription of the speech given in Milan in June 2003.

The Second Part comprises the lectures of the invited speakers, namely Sergio Barabaschi, Graham C. Goodwin, Hidenori Kimura and Giovanni Marro.

The first lecture is by Sergio Barabaschi, who contributed to control science and engineering in many capacities over several decades. In the 1950s, during his university days, he was attracted to the ideas of automatica after reading Leonard's book *Regelungstechnik*. He graduated from the State University of Milan in 1952, and in the late '50's and early '60's he was working at the Centro Ricerche Nucleari (Nuclear Research Centre) in Ispra, a town 50 km north of Milan. The primary goal of the Centre was to build the first Italian nuclear reactor. In order to provide suitable control engineering expertise for this project, a Laboratory of Servomechanism and Control was founded with more than 30 technicians and 20 engineers under the direction of Barabashi. Following the foundation of the European Community with the Treaty of 1957, the EURATOM (European Atomic Energy Community) was created, and the Ispra Centre became the location for EURATOM. Later the Laboratory of Servomechanism and Control was moved to La Casaccia near Rome, where another nuclear centre was situated, the Centro Nucleare della Casaccia. Barabaschi remained here until 1975, when Ansaldo, a major Italian company in Genoa, asked for his assistance as a control expert. In the middle of the '90's he held a number of positions in public institutions. In particular, from 1996 to 1998, he served as President of the European Industrial Research and Management Association, in Paris, and subsequently as President of the European Science and Technology Assembly (ESTA) in Bruxelles until 2000. He acted as Vice President of the European Council of Applied Science and Engineering at Academie de France in Paris until 2004. Sergio Barabaschi had the privilege to take part in the first *Convegno Internazionale sui Problemi dell'Automatismo* of 1956, so he has first hand experience from those memorable days. His paper is an inspiring description of the early years of automatic control in Italy and around the world.

The second invited lecture is by Graham C. Goodwin, who is a world wide recognised research leader in control engineering. He is a Professor of Electrical Engineering in the University of Newcastle (Australia) and Laureate Director of the University's Australian Research Council (ARC) Centre for Complex Dynamic Systems and Control. He has written many papers which have had high impact in academia and industry and his books are used in many universities around the world. He is the recipient of many prizes and awards from different societies and organizations. He recently received the prestigious Quazza medal from the International Federation of Automatic Control (IFAC). He is a Fellow of the Australian Academy of Science, the Royal Society, London, the Institute of Electrical and Electronics Engineers (IEEE) and the International Federation of Automatic Control (IFAC). His paper is about the past, present and future of digital control, and it covers many lines of research along which the discipline has grown in the last decades and is expected to evolve in the future.

The third invited speaker is Hidenori Kimura, Professor Emeritus of The University of Tokyo as well as Professor Emeritus of Osaka University. His outstanding contributions

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*in control theory have received worldwide recognition. In the last decades he devoted his attention to the control mechanisms governing living organisms. He is now Head of the Biological Control System Laboratory of the Institute of Physical and Chemical Research (RIKEN) in Nagoya. In his laboratory researchers from different backgrounds, including engineers, medical doctors and experimental biologists, collaborate with the aim of deepening the understanding of living organisms from the viewpoint of control and applying the research outcomes to achieve a better quality of life for human beings. Not only has he received many awards, but he has also held many highly distinguished positions, such as associate member of The Science Council of Japan and Vice President of Transdisciplinary Federation of Science and Technology. His lecture is an inspiring introduction to the control issues in life sciences.*

*The fourth invited lecture is by Giovanni Marro, Professor at the University of Bologna (Italy). He has been visiting scholar at many Universities, among them the Case Institute of Technology, Cleveland, the University of California, Berkeley, and the University of Florida, Gainesville. He is well known as the pioneer of the geometric approach to control. His renowned paper published in 1969 in the Journal of Optimization Theory and Applications is widely recognised as the spark from which the field developed. Giovanni Marro belongs to a group of senior Italian control scientists who contributed to the diffusion of systems and control ideas in Italy and abroad. He is still very active, and participates in many international conferences. His textbooks have been used by at least two generations of Italian students in the field of systems and control. His essay is a comprehensive and light presentation of the geometric approach to control.*

*The Third Part of the book is a report on the final Round Table discussion, with three distinguished panellists: Leone D'Alessandro, President of ANIPLA (Associazione Nazionale per l'Automazione – National Association for Automation), Attilio Skoff (Associazione Nazionale di Elettrotecnica, Elettronica, Automazione, Informatica e Telecomunicazioni – National Association for Electrical and Electronic Engineering, Automation, Computer Engineering and Telecommunications) and Antonio Vicino, President of CIRA (Centro Interuniversitario di Ricerca in Automatica – Interuniversity Centre for Automatica).*

*The list of participants ends the volume.*

*This book has two key objectives: Firstly to put half a century of Control Science into perspective, starting from the Convegno Internazionale sui Problemi dell'Automatismo of 1956. Secondly to provide a vision for the future. The retrospective view does not lay any claim to completeness. Its purpose is to provide an (incomplete) recollection of some events saving them from oblivion. As for the vision towards the future, back the 1920s, Niels Bohr said, "Predictions are hard, especially if they concern the future." Of course that is still true today. However, we hope that this volume will offer some hints on what the research will bring in the years to come. Those of the readers who will have the fortune to take part in the next event of the series, namely the Third Convegno Internazionale sui Problemi dell'Automatismo to be held in 2056, will be able to assess the correspondence between the development of the field and the predictions provided in this volume.*



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*The conference Chairperson and editor of this volume is extremely grateful to all speakers for the tremendous amount of effort they have put into their contributions.*

*The Convegno was made possible thanks to the generous support of the Politecnico di Milano, the CNR - Consiglio Nazionale delle Ricerche, and a National Research Project funded by the Italian Ministero dell'Università e Ricerca and Ministero della Pubblica Istruzione.*

*The reprint leading to this second edition has been funded by the ICT Department of the CNR.*

*Sergio Bittanti*

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# A Century of Control Science A Mid Term Reflection

Sergio Bittanti

## Foreword

This paper is based on the address of the author at the opening of the 2<sup>nd</sup> *Convegno Internazionale sui Problemi dell'Automatismo*, given at Politecnico di Milano, Italy, on September 18, 2006. This meeting, held 50 years after the first memorable conference with the same name, featured historical addresses, introductory lectures and tutorials of great interest, on the past, present and future of control science. Considering that the third meeting of the series is planned for year 2056, this event could be seen as a mid-term reflection in a century of control science, a half of which belongs to our past and a half which extends into the future.

The paper does not have any claim of completeness. Rather it presents a few haphazard remarks on the author's personal experience on a limited number of events, institutions and scientists who contributed to the development of control up to its present status. Special attention will be given to the role played by the National Research Council of Italy (*Consiglio Nazionale delle Ricerche – CNR*).

## 1. The “Science Days” of the ‘50’s

Since the early days of human civilization, automatic control systems have been conceived for the operation of man made machines. Furthermore much more sophisticated control systems are obviously active in any living organism. However, Control Science as an independent discipline has developed only in the XX-th Century. After some initial decades of specific applications spurred by industrial needs and military requirements, the field witnessed a paradigm shift about fifty years ago, under the impact of remarkable scientific discoveries. This gave rise to a new and awesome field, rich with theoretical challenges and multidisciplinary applications. At about the same time, an actual “control community” recognized its own identity and organized itself into international scientific societies. Early signs of this scientific evolution were some events which took place in various locations worldwide.

In Italy, in the '50's the Italian National Research Council (*Consiglio Nazionale delle Ricerche – CNR*) organized a series of yearly meetings on specific topics of wide interest to science and public. These meetings, taking place at the same time as the *Fiera di Milano* (Big Milano Fair) were called *Giornate della Scienza* (Science Days). They not only consisted of scientific conferences but also of initiatives of various kinds, such as exhibitions, round table discussions and screenings of scientific movies, in order to bring emerging areas to the attention of the general public. As can be read in [1],

“Tali manifestazioni hanno avuto lo scopo precipuo di sottolineare l’apporto che la ricerca scientifica può dare al progresso delle condizioni di vita, sia nell’ambito del nostro Paese, sia un quello più vasto dell’umanità. A tale finalità si è unita quella, altrettanto importante, di sottoporre all’esame degli studiosi e dei tecnici, attraverso il vaglio della pubblica discussione, alcuni problemi di particolare attualità ed interesse nel campo scientifico.”

“The main purpose of those events was to highlight the contribution of scientific research to the improvement of quality of life in our country and in the world. A second equally important objective was to submit scientific problems of current interest to public discussion by scholars and technicians.”

This series was initiated in 1951 according to the following schedule:

1951

*Il Contributo della Scienza allo Sviluppo delle Fonti di Energia*

(The Contribution of Science to the Development of Energy Sources)

1952

A) *La Difesa del Suolo e le Sistemazioni Fluviali e Montane*

(Land Protection and River and Mountain Management)

B) *La Propulsione a Reazione*

(The Reaction Propulsion)

1953

*Convegno sulle Vitamine*

(Congress on Vitamins)

1954

*Convegno di Elettronica e Televisione*

(Electronics and Television Congress)

1955

*Convegno Internazionale sui Problemi della Ricerca Scientifica*

(International Congress on the Problems of Scientific Research)

1956

*Convegno Internazionale sui Problemi dell’Automatismo*

(International Congress on Automatica Problems)

Our attention focuses on the *Convegno Internazionale sui Problemi dell’Automatismo*. Its truly international character and the extraordinarily large number of attendees made this conference a unique event in those early days of control, deserving a moment of reflection half a century later. Considering the development of the field in our days, as witnessed by the number of workshops, symposia and congresses on a wide variety of theoretical aspects and applications, we felt it appropriate to celebrate that memorable *Convegno* of 1956 with a set of foresight essays, on the future of Control Science. Considering that the third meeting of the series is planned for the year 2056, this second *Convegno* can be seen as a mid-term reflection in a century of control studies, a half of which belongs to our past and a half which extends into the future.

## 2. The “Convegno” of 1956

Held from the 8<sup>th</sup> through to the 13<sup>th</sup> of April of 1956 in the *Museum of Science and Technology* in Milan, the *Convegno Internazionale sui Problemi dell'Automatismo* consisted of a scientific Congress accompanied by an exhibition for the general public.

The congress included more than 1000 attendees from many countries. Presentations were organized in several parallel sessions, and they were collected in three volumes published two years later by the CNR. The first volume of these Proceedings consisted of 884 pages, the second of 950 pages and the third of 541 pages. In total some 270 papers, most of them in Italian and English, with a few in French and German. All papers included the summaries in those four languages. The opening page of the first volume is reproduced in Fig. 1.

The *Organizing Committee* was chaired by the President of the CNR, Gustavo Colonnetti. The Vice-Presidents were Ivan Matteo Lombardo, professor at the Politecnico di Milano and member of the Parliament, and Algeri Marino, professor of Electrical Communication at the University of Rome and President of the *Fondazione Bordini*. The history of this foundation, which was hosted at the *Istituto Superiore delle Poste e delle Telecomunicazioni* (Higher Institute of Post and Telecommunications) in Rome, will be outlined in Section 3.4. For the moment, we only mention that it included various research laboratories, among them an Automatic Control Lab which began its activities in 1955.



Fig. 1 – The first page of the first volume of the Proceedings of the Convegno of 1956

The full list of participants is reported at the end of the third volume of the Proceedings. Among them we mention Aizerman, Boulanger, Bruns, Gerecke, Hamos, Kogan, Leonard, Pélegrin, Raymond, Solodovnikov, Scott, Sotskov, Tsypkin (spelled as Cypkin), West. As for the Italians, Barabaschi, Busa, Camatini, Ceccato, Costadoni, Chiesa, Gatti, Lepschy, Piglione, Quazza, Ruberti and Volta. Later we will dwell upon the activity of some of these distinguished Italian scholars.

The *Convegno* was opened by Gustavo Colonnetti (Fig. 2). His speech is really worth reading nowadays. The paper, in Italian, is entirely reproduced in Appendix 1. It is followed by its summary in French, English and German. The English abstract is reproduced below:

### *Automation and its basic aspects by Gustavo Colonnetti*

*The author begins with an analysis of the different meanings of the term “automation” and formulates a very precise and comprehensive definition of such a term. He then discusses various problems connected with automation from a scientific, technical, applicational, financial and social point of view.*

*From the scientific and technical points of view it is stressed that the modern automatic systems should satisfy the following two basic requirements: 1) overall security and absolute continuity of operation 2) costs reduced to a minimum with respect to installation maintenance and operation.*

*The author also examines the condition capable of guaranteeing the accomplishment of such requirements.*

*As for the application of automation, particular emphasis is put on the fact that the most important problem to be solved in this field is the determination of the limits of economical convenience of automatic proceedings compared to manual proceedings.*

*Finally, the author examines the problem also from the social viewpoint. He stresses the fact that from the social point of view automation is substantially a positive event provided that appropriate modifications are made in certain social fields, especially in the field of university and professional training.*

*The author concludes this paper by pointing out the necessity of a “National Automation Centre” with the purpose of examining and solving technical, scientific, applicational, economical, financial and social problems connected with automation.*

It should be remarked that the conference was open to all aspects of automation, as witnessed by session titles:

#### Vol. 1

- 1.A Definition and classification of automation systems
- 1.B Theory of automatic control
- 1.C Technique of automatic control
- 1.D Computing machines
  - 1.D.1 Speaking and translating machines



*Fig. 2 - G. Colonnetti giving his opening address at the "Convegno" of 50 years ago. (Colonnetti was President of the National Research Council from 1944 to 1956) At his right the Rector of the Politecnico di Milano, G. Cassinis (actually, in those days the Rector was indeed named "Director"). At his left, G. Corbellini, Minister of Transportation and professor at the Politecnico di Milano*

Vol. 2

- 2.A Automation in industrial production
  - 2.A.1 Equipments for industrial automation
  - 2.A.2 Automatic plants for industrial production
  - 2.A.3 Automation in the textile industry
- 2.B Automation in the public and private services
  - 2.B.1 Land, sea and air transports
  - 2.B.2 Telecommunications
  - 2.B.3 Production and distribution of electrical energy
  - 2.B.4 Miscellaneous applications
- 2.C Automation in the organization of public bodies

Vol. 3

- Economic and social consequences of automation
  - 3.A Economic aspects of automation
  - 3.B Social aspects of automation
  - 3.C Educational aspects of automation

One may be surprised that the first session was entirely devoted to the definition and classification of control. However, this was a main issue back then, and it will be further discussed by Sergio Barabaschi in his essay about the early days of automatic control in Italy.

The twin exhibition, named *Mostra Internazionale dell'Automatismo (International Exhibition on Automation)*, was full of stands exhibiting products from many companies, some of which can be seen in Fig. 3.

The expectations from automation were so remarkable that the participation of the public in the exhibition was huge, according to the newspapers of those days. I have consulted the main Italian newspaper *Corriere della Sera* of 1956 and I have noted the following articles:

*Corriere della Sera*

April 3

Una "giornata della scienza" indetta dal Consiglio delle Ricerche  
(A "Science Day" organized by the Research Council)

*Corriere della Sera*

April 10

Le giornate della scienza a Milano:

L'avvento dell'automazione potrà compiersi solo per gradi

(*The science days in Milan: The advent of automation will be possible only gradually*)

*Corriere della Sera*

April 11

La mostra internazionale dell'automatismo a Milano:

L'aviatore può addormentarsi se c'è l'autopilota elettronico

(*The international exhibition on automation in Milan: the pilot of the plane can sleep if there is an electronic autopilot*)

*Corriere della Sera*

April 14

Si è concluso il congresso sull'automatismo:

Sono sempre macchine i più perfetti cervelli elettronici

(*The congress on automation is over: Even the most perfect electronic brains are after all machines*)

The exhibition was also visited by the President of the Italian Republic, Giovanni Gronchi (Fig. 4), who also took part in the closing ceremony of the Science Days, together with other authorities (Fig. 5).

### 3. Further memorable events of 1956

Many embryonic events concerning automatic control took place in 1956, warning signs of the big bang of control as an independent discipline. The general atmosphere in various countries during the early developments of automatic control is well accounted for in the next paper by Sergio Barabaschi. The reader is also referred to the histor-

ical special issues of the IEEE Control Systems Magazine (2004), [2], and the European Journal of Control (2007), [3].

In Italy, three further events marked the year 1956. On February 20 the ANIPLA (*Associazione Nazionale Italiana Per l'Automazione*) association was founded as a channel for dissemination of information on all aspects of automation, from technological, economical and social viewpoints. ANIPLA has over the years taken many initiatives to connect people at universities and industry. Today this association is hosted in the building of the Federation of Scientific and Technological Associations FAST (*Federazione delle Associazioni Scientifiche e Tecniche*). This building is located in Milan in the square where the Politecnico di Milano, founded in 1863, had its first location. Secondly, in 1956 the first exhibition named BIAS (convegno-mostra *Biennale Internazionale dell'Automazione e Strumentazione*) took place. This exhibition is also active today, and it is held every three years in Milan. Lastly, from the 16-th to the 21-st of September, 1956, the 57-th annual meeting of the Italian Electro-technical Association AEI (*Associazione Elettrotecnica Italiana*) was held in Trieste, and it was devoted to *Regolazione Automatica e Servomeccanismi*.

Turning to the international scenario, we will focus on the origins of a main association, the *International Federation of Automatic Control* (IFAC), with special attention to the role of Italian scholars, as outlined in [4].

### ***3.1 The birth of IFAC from an Italian perspective***

A few months after the *Convegno Internazionale sui Problemi dell'Automatismo*, to be precise on the 27<sup>th</sup> of September of 1956, a congress named *Automatic Control Congress* was held in Heidelberg (Germany). During this meeting a small group of scientists and engineers from different countries took the first steps towards founding an international institution for automatic control and its applications, the *International Federation of Automatic Control* (IFAC). The declaration they signed is reproduced in Fig. 6. A member of this group was the eminent Italian scholar, Giuseppe Evangelisti who was professor of Hydraulics at the University of Bologna. One year later the Heidelberg meeting was followed by the Constitutive Assembly of IFAC, held in Paris on September 11<sup>th</sup>, where a preliminary version of the constitution of the new Federation was prepared.

During the negotiations and discussions following these two events, Evangelisti proposed a formal meeting to be held in Italy for the finalization of the constitution. His proposal was immediately accepted by the provisional committee of the new federation.

In order to prepare for this meeting, Evangelisti contacted Algeri Marino, who served as Vice-President of the Organizing Committee of the *Convegno* of '56 and was President of the *Fondazione Bordini*. Following Evangelisti's request, Marino obtained permission to set up the *CNR Commission for IFAC*. Its presidency was entrusted to Evangelisti with Marino as a member of the board; Antonio Lepschy and Antonio Ruberti, two young professors working in the laboratory of automatic control of the *Fondazione Bordini*, were nominated secretaries. Lepschy and Ruberti were also involved in the Organizing



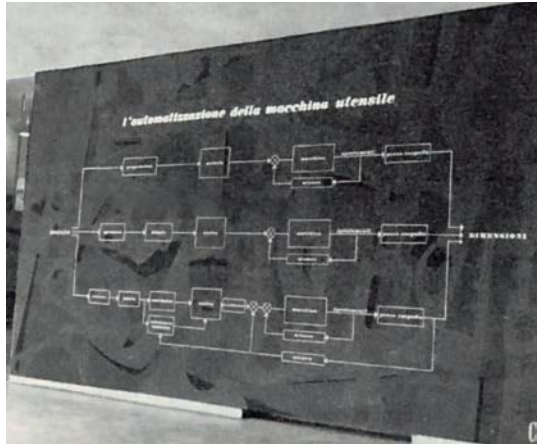
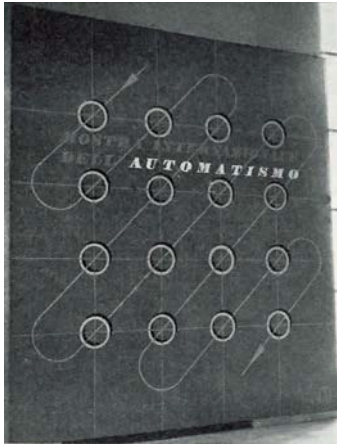


Fig. 3 - Pictures from the Mostra Internazionale dell'Automatismo



*Fig. 4 - President Gronchi visiting the Mostra dell'Automatismo*



*Fig. 5 - President Gronchi at the closing ceremony of the Science Days of 1956. At his right G. Leone, who became President of the Italian Republic after Gronchi*

Committee of the *Convegno Internazionale sui Problemi dell'Automatismo* as *General Secretaries*. Through this *Commission*, CNR was to become the Italian authority supporting IFAC, thus taking responsibility for the financial commitments. This role continues today.

Starting from the 20<sup>th</sup> of January, 1958, the *CNR Commission for IFAC* met on several occasions, with the main purpose of collecting and coordinating the proposals that were formulated by the members of the provisional committee for the IFAC statute. In accordance with the proposal by Evangelisti, a meeting was going to be organized in Rome with the purpose of preparing for formal foundations of the new organization. To this end, the *CNR Commission for IFAC* produced a document which was submitted to the meeting for approval.

The Rome meeting was held at the CNR headquarters from the 2<sup>nd</sup> through to the 6<sup>th</sup> of March, 1959. This is where the proposed Constitution was finalized, and submitted to all National Member Organizations in preparation for the General Assembly of IFAC, which would take place in Chicago in September.

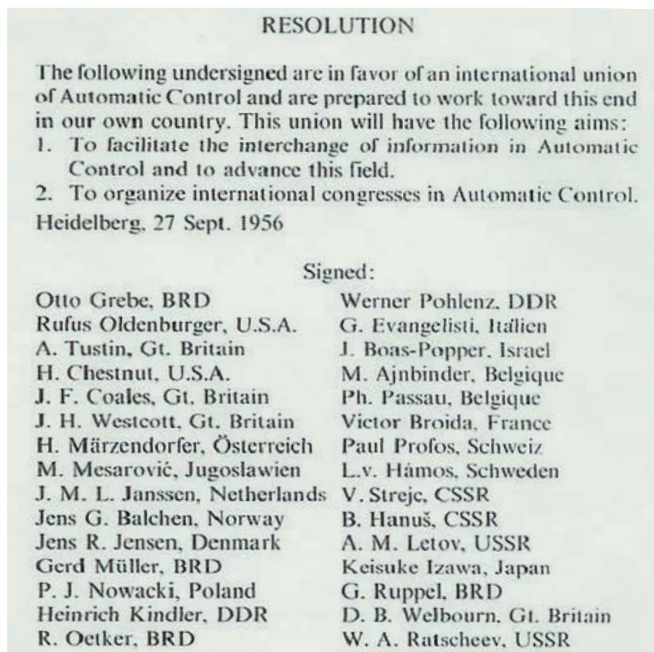


Fig. 6 - The Heidelberg resolution (September 27, 1956)

Already in 1958, IFAC started a series of information bulletins (the cover of the 1<sup>st</sup> bulletin dated May 1958 is reproduced in Fig. 7). These bulletins are a main reference for the early days of control.

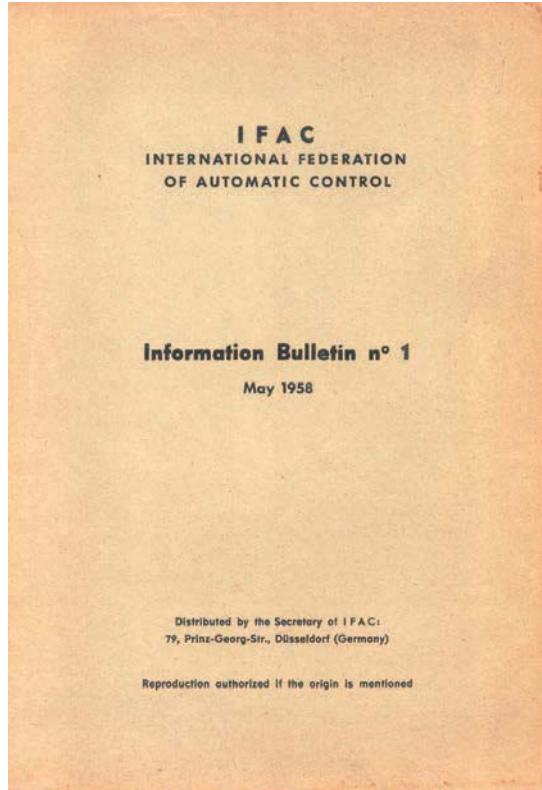


Fig. 7 – The 1<sup>st</sup> information bulletin of IFAC (May 1958)

The sequence of events above outlined is appropriately summarized in the 4<sup>th</sup> Information Bulletin of May 1959, where one can read:

#### “Meeting of the Executive Council and the Advisory Committee

Upon invitation of the Italian National Research Council, the Executive Council and the Advisory Committee of IFAC had a meeting in Rome from March 2 to 6, 1959. All the members of the Executive Council were present with the exception of H. S. Tsien (China) for whom S. M. Chung was present. The other members of the Executive Council are:

H. Chesnut (USA), (President of IFAC), M. Ajnbinder (Belgium), V. Broida (France), J. F. Coales (United Kingdom), G. Evangelisti (Italy), E. Gerecke (Switzerland), A. Letov (USSR), P. Nowacki (Poland), G. Ruppel (Germany).

Moreover, the following members of the Advisory Committee and guests were present at least during part of the meeting:

J. Balchen (Norway), O. Benedikt (Hungary), D. P. Eckman (USA), F. Foddis (Italy), W. Findeisen (Poland), K. Izawa (Japan), R. Oldenburg (USA), W. Oppelt (Germany), Z. Trnka (Czechoslovakia).

All items of the very large agenda were discussed in a very friendly spirit and with whole-hearted co-operation of each member. The Italian National Committee of IFAC had prepared all facilities and had extended a very friendly hospitality.

The following report is to inform our readers about several resolutions which might be of special interest.”

Some points are then developed, in particular point 4 reads:

*“4. Constitution of IFAC:*

The Constitution which has been adopted at the Constitutive Assembly of IFAC September 1957 in Paris had found some criticisms among several National Member Organizations. A special committee under the chairmanship of Prof. G. Evangelisti (Italy) had collected and coordinated all proposals for amendments of the Constitution and has taken these comments as a basis for a new draft which was thoroughly discussed by the Executive Council. The new draft including some more modifications will be submitted to all National Member Organizations before long in order to vote on it on the General Assembly to be held in Chicago in September 1959.”

The Chicago meeting took place at the Sheraton Chicago Hotel, from the 14<sup>th</sup> to the 18<sup>th</sup> of September 1959. The consulting Committee gathered on September the 14<sup>th</sup> and 15<sup>th</sup>, whereas the actual meeting took place, in a very friendly and enthusiastic atmosphere, on the 16<sup>th</sup>, 17<sup>th</sup> and 18<sup>th</sup>. Informal meetings also took place among the representatives of national associations, and with the official bodies of the main western countries, Japan, and the East European countries. These meetings and exchanges were also facilitated by social occasions like the cocktail party offered by Professor Jones on the 16<sup>th</sup>, a barbecue at Doctor D. Boyd’s home in Evanston the 17<sup>th</sup> and the official banquet at the Sheraton Hotel on the 18<sup>th</sup>, where Professor Gerecke of the Zurich Polytechnic gave a speech, illustrating the things that impressed him the most during his visit to the United States (things that, at that time, were not very widespread in Europe, but were, however, soon to be). The Chicago meeting also offered the opportunity for many participants to visit an important exhibition on instrumentation organized by ISA in the Coliseum.

The Italian delegation to the Chicago Meeting consisted of Giuseppe Evangelisti, a member of the consulting Committee of IFAC, Antonio Lepschy and Antonio Ruberti. The latter two were responsible for presenting Algeri Marino’s lecture on the problems of university education in the field of automatic control and automation. This lecture was presented by Lepschy and discussed in the consulting Committee afternoon session on September the 14<sup>th</sup>. During the travel back to Italy, Evangelisti, Lepschy and Ruberti made a stop to visit the IBM World Trade Corporation in Poughkeepsie on the 24<sup>th</sup> of September. The photograph of Fig. 8 was taken during that visit.



*Fig. 8 – The Italian delegation at the Chicago meeting visiting the IBM World Trade Corporation in Poughkeepsie (USA) on the 24<sup>th</sup> of September 1959*

*Seated left to right: A. Lepschy and G. Evangelisti.*

*Standing left to right: G. Simons of IBM and A. Ruberti*

The Chicago meeting anticipated the first IFAC World Congress, held in Moscow from June the 27<sup>th</sup> to July the 1<sup>st</sup>, 1960. This Congress was the first of a long series of IFAC events, which were to take place in many different countries. IFAC events are nowadays split into workshops and symposia, depending on the expected number of attendants. The World Congress is held once every three years, and no other IFAC event is organized that year.

In the period from the Moscow congress to the following IFAC World Congress in Basle, Switzerland in 1963, Italy had the privilege of hosting the first symposium organized under the aegis of IFAC. The symposium, held from the 26<sup>th</sup> to the 28<sup>th</sup> of April 1962, was devoted to optimisation and adaptive control and, upon the initiative of CNR, was held in Rome at the *Istituto Superiore delle Poste e delle Telecomunicazioni* (*Higher Institute of Post and Telecommunications*), headquarters of the *Fondazione Bordini*. The welcoming address was given by Giovanni Polvani, who became President of the CNR in 1960 and served in that position until 1965. This event, held more than 40 years ago, was the first official IFAC event in Italy. It was to be followed by many others, as witnessed in [4].

### **3.2 IFAC organizations and IFAC Congresses**

IFAC is a multinational federation of National Member Organizations (NMO's), each one representing the engineering and scientific societies concerned with automatic control in its own Country. Currently the Federation is composed of a little less than 50 NMO's. Currently the Italian NMO is the Commission of the National Research Council, the *CNR Commissione IFAC*, chaired by Edoardo Mosca of the University of Florence since 1993. Previously, the Chairman was Guido O. Guardabassi (Politecnico di Milano) for about two decades.

IFAC is organized in many committees. The Federation is ruled by the *IFAC Council* (originally named the *Executive Committee*). The Council makes the main decisions, such as acceptance of new countries into the Federation, selection of the location of IFAC World Congresses, selection of the country to hold the Presidency, and so on.

Many Italian scholars have contributed to the IFAC development in various capacities, especially as Chairpersons of the Technical Committees. They are so many that it is impossible to list all of them here. We only mention the Italians who served as members of the IFAC Council: 1957-1961: G. Evangelisti; 1975-1981: G. Quazza; 1981-1984: U. Pellegrini; 1984-1990: G. Guardabassi; 1993-1996: A. Isidori; 1996-2002: E. Mosca; 2002-2005 the author of this paper. Giorgio Quazza was a member of the Executive Committee from 1975 to 1978; then in 1978 he was elected again for his second term of office for the subsequent triennium 1979-1981, but he died in 1978.

The top IFAC event is the IFAC World Congress, organized every three years. Many scientists consider this event as the most eminent conference in control.

After the Congresses of Moscow (1960) and Basle (1963), the following ones were held in London (1966), Warsaw (1969), Paris (1972), Boston (1975), Helsinki (1878), Kyoto (1981), Budapest (1984), Munich (1987), Tallinn (1990), Sydney (1993), San Francisco (1996), Beijing (1999), Barcelona (2002), Prague (2005), Seoul (2008).

In the triennium 2002-2005, the IFAC World Congress 2011 was assigned to Milan with the author of this paper serving as Chairperson. The Presidency of IFAC for the period 2008-2011 leading up to the Congress has been assumed by Alberto Isidori, professor at the University of Rome "La Sapienza" and leading personality in nonlinear control theory. Due to IFAC regulation, the *IFAC President Elect* automatically takes part in the Council activities, so that we do not expect other Italian members of the Council until 2011, when the Milan Congress will be concluded and the Italian Presidency will be over.

The decisions concerning the IFAC Congress 2011 and Presidency 2008-2011 were the outcome of a long process which culminated in two meetings, the first one in Rotterdam and the second one in St. Petersburg. In Rotterdam on the 30<sup>th</sup> of August 2003 the IFAC Council met and selected two finalists among the bids for the 2011 Congress; the final decision was taken during the IFAC Council meeting in St. Petersburg on the 19<sup>th</sup> of June 2004. In those years, from the Barcelona Congress of 2002 up to the Prague Congress of 2005, I was a member of the IFAC Council and acted as promoter of the proposal. I presented the Italian bid in both meetings quoted above with the help of the proposed President Alberto Isidori. The preparatory work for this successful outcome started many years before, in 1997, when a task force of Italians was formed on my initiative. The representative of the Italian National Member Organization (NMO) of IFAC Edoardo Mosca, professor at the University of Firenze and distinguished expert of adaptive control, was enthusiastic and provided helpful suggestions. Since the beginning, I suggested Alberto Isidori as President with the unanimous support of the task force members. The first informal gathering of the Italian control community on the matter took place in Beijing at the time of the 14<sup>th</sup> IFAC World Congress of 1999. In the subsequent

months, together with Roberto Tempo, distinguished control scientist of the CNR Institute IEIT located in Torino, I visited a number of congress centres in Italy in order to make the best choice of the venue. The final decision was Milan, and this was the Congress location referred to in the presentations of the bid in Rotterdam and St. Petersburg. For the promotion of the Italian bid many initiatives were taken. First of all, we offered a dinner during the Barcelona Congress of 2002, jointly with the other countries interested in the Congress of 2011. This event, known as the *friendship dinner*, is now a standard initiative taking place during the IFAC Congresses. It is undertaken by those NMO's of IFAC willing to propose a bid for the subsequent congress. Second, we worked out the volume *Italy in IFAC* with the announcements of all IFAC conferences held in Italy. That volume was distributed during the *friendship dinner* in Barcelona. I remember that the volumes arrived just a few hours prior the dinner although they were sent out from my Department various days before. Secondly we prepared a booklet of support letters. It contained a letter from the IFAC National Member of Organization of Italy signed by its President Edoardo Mosca, followed by a letter jointly signed by the proposed Chairperson and the proposed President. These two invitation letters were complemented by many other support letters which can be grouped as follows:

#### From Ministers

Minister of Education and Research (Mrs. Letizia Moratti)  
Minister of Productive Activities (Mr. Antonio Marzano)  
Minister of Foreign Affairs (Mr. Franco Frattini)

#### From the National Research Council of Italy (CNR)

Commissioner of National Research Council (Mr. Adriano De Maio)

#### From local authorities

Governor of Region Lombardia (Mr. Roberto Formigoni)  
Mayor of Milano (Mr. Gabriele Albertini)

#### From companies

AGUSTA - Varese (Helicopters)  
(Chairman Amedeo Caporaletti)  
CESI - Milano (Energy)  
(Managing Director Giulio Santagostino)  
COMAU - Torino (Robotics)  
(Corporate Senior Vice President Massimo Mattucci)  
ENEL Power (Energy Board)  
(Engineering Director Luca Lanfranchi)



FERRARI – Maranello (Cars)  
(Engineering Director Amedeo Felisa)  
FIAT RESEARCH CENTER – Torino (Cars)  
(President and Chief Executive Officer G. C. Michellone)  
FINMECCANICA (Aeronautics, energy and i.t. )  
(Chairman and Chief Executive Officer Pier Francesco Guargaglini)  
GALILEO Avionica – Roma  
(Chairman Giancarlo Grasso)  
PIRELLI – Milano (Tires)  
(Chairman and Chief Executive Officer Marco Trochetti Provera)  
ST Microelectronics – Milano  
(Microelectronics) (Administrator Enrico Villa)  
TELECOM Italia (Telephone and i.t.)  
(Chairman and Chief Executive Officer Marco Trochetti Provera)

#### From associations and public foundations

ANIE (Nat. federation of electrical and electronic companies)  
(President Gian Francesco Imperiali)  
ANIPLA (Italian Nat. Association for Automation)  
(President. Luca Ferrarini)  
ASSOLOMBARDA (Association of Industrial and Tertiary Entrepreneurs)  
(President Michele Perini)  
CHAMBER OF COMMERCE  
(President Carlo Sangalli)  
CARIPLO FOUNDATION  
(President Giuseppe Guzzetti)  
POLITECNICO FOUNDATION  
(President Giampio Bracchi)  
UCIMA (Italian Association of Automatic Packing and Packaging Machinery  
Manufacturers)  
(President Marco Vacchi)

Moreover we received warm support letters from the Rectors of Politecnico di Bari, University of Bologna, University of Catania, University of Firenze, University of Genova, Politecnico di Milano, University of Napoli Federico II, University of Padova, University of Pavia, University of Roma La Sapienza, Politecnico di Torino, and, last but not least, from *all* Professor of the control field in the Italian Universities.

The task force was originally composed by Claudio Bonivento (University of Bologna), Alberto Isidori (University of Roma La Sapienza), Edoardo Mosca (University of Firenze), Giorgio Picci (University of Padova), Roberto Tempo (CNR, Torino), besides myself. This committee played a major role in deciding the initiatives to be taken for the promotion of the bid and for the collection of the sponsoring letters in a united joint effort.

The Italian team is already working on many issues related to the Congress. In Figs. 9 - 11 one can see some studies for the logo and poster.

At the 17<sup>th</sup> IFAC World Congress of Seoul in July 2008, the poster of the 2011 Congress was distributed to the participants in a golden colour envelope. Warm invitation letters have been written by the Mayor of Milan, the President of the National Research Council of Italy (CNR) and the Ambassador of Italy in Korea.

Il Sindaco

Milano

Comune  
di Milano

Distinguished scientists and engineers,

I am very glad to know that the 2011 IFAC World Congress will be held in Milan.

"Automation and Control" has always been central to our science and the related technologies have been the base for the success of many our industries in the international arena.

The level of excellence reached by our research centres also led to significant advances in various fields, such as robotics, energy, automotive industry, aerospace, life sciences. Today Milan is the leading Italian centre for research, innovation and production in the subject of your interest .

I may remember that as back as 1956 two important meeting have been held in our town: " *The International Conference on the Problems of Automatic Control*", and " *The International Exhibition on Automation*" with the participation of many thousands people.

The city of Milan is also full of activities and cultural life, and offers many opportunities to visitors for its cultural heritage and historical buildings. Milan is, among others, the international centre of excellence for the fashion industry.

Leonardo da Vinci, the 15<sup>th</sup> Century engineer and artist, lived here for two decades during his maturity, leaving a legacy which is still alive. One of his masterpieces as an artist is the "*Last Supper*", which is located in "Santa Maria delle Grazie", an historical church in our city. His activity as a scientist and an engineer is witnessed by the machines he invented; many of them have been reproduced and can be admired in our "*Science and Technology Museum*". His major contribution to water hydrology is an early example of control engineering; thanks to his studies on the regulation of locks, the passage of vessels through channels at different water level became possible.

For all these reasons, I would like to express my deepest thanks for your choice and extend to all participants of the IFAC World Congress in Seoul and to their families my warmest invitation to join the 2011 Congress: see you in Milan !

With my best regards,



Palazzo Marino  
Piazza della Scala, 2 - 20121 Milano  
tel. +39 02884.50000 - fax +39 02884.50591



*Consiglio Nazionale delle Ricerche*

IL PRESIDENTE

PRESID - CNR - Presidenza		
Tit:	Ci:	F:
<b>N. 0002436</b>		<b>30/05/2008</b>



To the participants in Italian Dinner at the 17-th IFAC World Congress in Seoul

Distinguished control scientists and engineers,

the National Research Council of Italy (Consiglio Nazionale delle Ricerche – CNR) has a long tradition as a leading Italian institution for the coordination of advanced research studies. In particular the CNR promotes the research activity on automatic control via the creation of ad hoc Institutes, the support of national research projects, and the sponsorship of workshops and conferences.

Memorable is the Convegno Internazionale sui Problemi dell'Automatismo, organized by the CNR already in 1956, one of the first international congresses on automatic control, with a large attendance of more than 1000 participants from many different Countries.

Ever since the CNR is the Italian institution having the responsibility of the association of Italy within the International Federation of Automatic Control (Italian NMO).

The Research Council of Italy is glad to know that the next IFAC World Congress will be held in Italy, and express to all of you a warm invitation to that Congress in three years time.

With the CNR compliments,

Luciano Maiani



*Embassy of Italy  
Seoul*

**IFAC World Congress 2008**  
*Seoul 9<sup>th</sup> July 2008*  
**"Cena italiana"**

**Address by H.E. Massimo Andrea Leggeri  
Ambassador of Italy to the Republic of Korea**

Honorable Authorities,  
Korean and Italian Scientists,  
Italian delegation from Milan,  
Control scientists and engineers from all around the world,  
Ladies and gentlemen,

I am really glad to be here today, to represent the transit between the IFAC World Congress 2008 held by the city of Seoul and the next one that the city of Milan will host in 2011. The triennial IFAC World Congress is indeed the most relevant event in the field of automatic control, a forum which gathers thousand of scientists and engineers aiming to exchange scientific results, innovations and experiences.

I would like to thank the Korean organizers for the successful IFAC 2008 event and the Italian organizers, especially professor Sergio Bittanti, for the forthcoming IFAC 2011 which will take place in Milan.

This selection witnesses the excellent level reached by Italy in control science and technology and confirms Milan, already designed to hold the EXPO 2015, as one of the most advanced reality on the global industrial scenario and, in this case, in the field of industrial controls. Being a centre of knowledge in this specific and strategic area means to contribute to the "development of competition in the whole economic system.

I am well aware that control plays a main role in a variety of fields, such as industrial automation, robotics, vehicle guidance, mechatronics, not to speak of life sciences and economics.

In industry, automation is crucial for increasing both, efficiency of production and quality of final products. I also believe that industrial companies without substantial investments in automation will have little chances to successfully compete and even survive in the forthcoming years. In this respect, effective links between industry and academic world are going to play an on going increasing role in the technological progress.

Not by chance Milan was chosen to host this event. Indeed, Milan is the heart of Italy's industry and the site of Universities among the most important in Europe. Strong support of this knowledge is given, as a matter of fact, from a well-known highly reputed institution like the Milan Technical University, namely the Politecnico di Milano, and its internationally recognized excellence in the field of control science and technology.

For these reasons Milan has always been interested in this kind of international events. Back in 1956 other two important initiatives have been held in the city: "The International Conference on the Problems of Automatic Control", and "The International Exhibition on Automation", both of them with the participation of thousands of specialists. This conference, together with the twin exhibition, is one of the few international events marking the dawn of control in the mid of past century.

However, Milan, as everybody knows, is not just known for its great results in the technological and industrial field. The city also offers a wide choice of cultural activities, historical buildings, culture and music. Milan is also known of course for being the international centre of excellence for the fashion industry that makes it the fashion's capital of the world. So, together with science and technology, Milan will offer a wide range of opportunities and cultural event to the distinguished guests coming all over the World.

Let me recall that the Mayor of Milan, on the occasion of her visit to Seoul, last February, was awarded by the Mayor of Seoul of the honorary citizenship of Seoul: how could we better underline the spirit unifying the role of these two cities and their leading role in advancing our societies!

As I hope to see all of you in 3 years time in Milan, I take this opportunity to deeply thank all of you for joining us today.

  
Massimo Andrea Leggeri  
*Ambassador of Italy*

In 2006, IFAC celebrated its 50<sup>th</sup> anniversary with a meeting (IFAC 50) held on Friday September the 15<sup>th</sup> in Heidelberg (Germany). For the occasion IFAC published a book, which is a summary of historic control textbooks published in the '50's, [5]. The presentation of the textbooks is organized country by country, and for each book the cover and a few pages are reproduced. Moreover, a contemporary control scientist from the same country as the author(s) of the book provides a short description of the circumstances leading to its writing. As for the contribution of Italian scholars, four textbooks are included:

“La Regolazione delle Turbine Idrauliche”

by *Giuseppe Evangelisti*

Zanichelli Editore, Bologna, 1947

“Teoria della Regolazione Automatica”

by *Giorgio Quazza*

Anipla, Milan, 1962

“Lezioni di Controlli Automatici”

by *Antonio Lepschy, Antonio Ruberti*

Siderea, Rome, 1963

“Elementi di Servomeccanismi e Controlli”

by *Sergio Barabaschi, Renzo Tasselli*

Zanichelli, Bologna, 1965

### **3.3. Italian scholars**

We are grateful to all our predecessors specializing in control for bringing the field to its current state of development. Not only can we now count on better tools for the design task, but also our research days are much more pleasant.

Among the many Italian scholars, we will focus here on a few names, with our apology for those who cannot be mentioned due to space limitations, and nonetheless contributed to make control such an exciting area.

Giuseppe Evangelisti (1903 -1981)

Graduated in civil engineering in 1927, he spent most of his professional life at the University of Bologna as professor of Hydraulics. His contribution to automatic control is witnessed by his book on the regulation of hydraulic turbines published in 1947 (*La Regolazione delle Turbine Idrauliche*, Zanichelli, Bologna). This book and the papers by Evangelisti are highly cited in the fluid dynamics literature. For example they are quoted in the celebrated *Handbook of Fluid Dynamics* (V. L. Streeter ed., first edition 1961, McGraw-Hill).

At the University of Bologna he founded in 1956 the *Computing and Servomechanism*

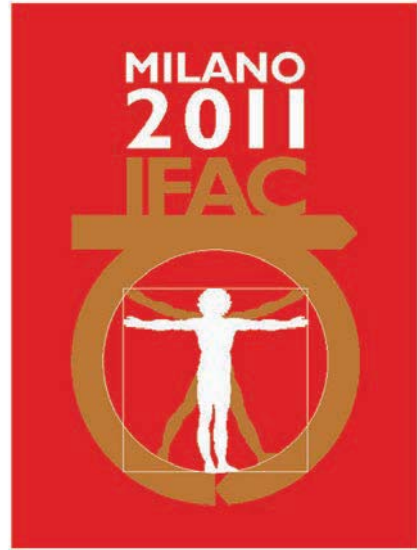


Fig. 9 - Studies of the logo for the 2011 IFAC World Congress to be held in Milan



Fig. 10 - Study of the poster for the IFAC World Congress to be held in Milan



Fig. 11 - Study of the postcard for the IFAC World Congress to be held in Milan

*Centre*, one of the first Centres of this type in Italy. Through the *CNR Commission for IFAC*, of which he was President, he was the main promoter for Italy to join IFAC. As a result, Italy was among the first 8 Countries to officially join IFAC in 1957 at the Constitution meeting of September 11<sup>th</sup>, 1957. He then became member of the first Executive Council of the Federation (from 1957 to 1961). To my regret I did not have the chance of meeting him personally. However, his attitude to the understatement remains in the memory of those who knew him. In particular the opening of his lecture given in Milano at the *Seminario Matematico e Fisico* on March the 15<sup>th</sup>, 1953 is memorable: “Perdonatemi, sono un matematico da strapazzo...” ( “Forgive me, I’m only kind of a mathematician...”). I refer the reader to [4] and [6] for more information on his contributions and his personality.

#### Antonio Lepschy (1931 - 2005)

Antonio Lepschy was one of the founders of automatic control in Italy and a main promoter of the field in Italian academia. Together with Antonio Ruberti, he was already active in research as early as 1955, while working for the *Fondazione Bordoni* in Rome. He was appointed professor of automatic control at the University of Bari in 1964. After that he taught in various Italian universities, among them Trieste and eventually Padova, where he served in various positions, such as dean of the faculty of engineering, department Chairperson and director of LADSEB, a very active laboratory of the *National Research Council*. He was member of various academic institutions such as the *Galilean Academy* in Padua, the *Istituto Veneto* in Venice and the *National Academy of Sciences Accademia dei XL*. Antonio Lepschy (Toni among friends) has been a polymath with cultural interests encompassing epistemology and linguistics. Besides his many books and publications in the field of automatic control he has co-authored a book on Italian linguistics. To honor him, the colleagues of Padua University worked out a volume of memories entitled *A tribute to Antonio Lepschy* and published in 2007.

#### Giorgio Quazza (1924 - 1978)

In September 1943 Giorgio Quazza left his studies in Engineering at the Politecnico di Torino to join the Italian Resistance Movement. Taken as a prisoner in December 1944 he was sent to the concentration camp of Mauthausen, where he remained until the end of the war. When he returned from Mauthausen, he concluded his studies with his master thesis and then moved for three years to the US where he received his PhD from the Brooklyn Polytechnic Institute. Returning to Italy, he settled in Milan, working at the Italian Electricity Board (ENEL) for many years. Here he founded the *Centro di Ricerca di Automatica* in 1967. This research centre was a main vehicle in the study of control. He was also professor of *Process Control* from 1971 to 1978 at the Politecnico di Milano. He was very active in IFAC, where he held various positions, and he was appreciated for the time and energy he devoted to the Federation. In August 1978 he passed away in a mountaineering accident. It was then decided to create the Quazza medal, an award to a distinguished control engineer under the responsibility of the IFAC Council, presented



at each IFAC World Congress (Fig. 12).

Quazza's memory was celebrated on June 26<sup>th</sup>, 2003, during the 4th IFAC Symposium on "*Robust Control Design*" (Milan June 25 - 27, 2003), in the occasion of the 25<sup>th</sup> anniversary of his death. The President of IFAC, Vladimir Kucera, was present at this celebration. Memorial speeches were given by Petar Kokotovic, Claudio Maffezzoni, Giancarlo Manzoni and Fabio Saccomanno. Kokotovic's speech, recorded at the Memorial, transcribed and edited in May, 2007, can be found in Appendix 2. At the end of the memorial, a plaque in memory of his contribution to control science was given to his family (Fig. 12). A photo of a group of participants at this event is shown in Fig. 13.

#### Antonio Ruberti (1927 - 2000)

At the end of his studies in Engineering at the University of Naples (where he was born), Antonio Ruberti moved to Rome in 1954. He enrolled in the *Fondazione Bordoni*, a foundation hosted in the *Higher Institute of Post and Telecommunications*. There, in the Laboratory of Automatic Control, he had the opportunity to meet Algeri Marino, the director of the laboratory. Marino was a professor of telecommunications and a person with significant connections with the *National Research Council*. In the same laboratory, Antonio Lepschy was then working. With him Ruberti established a lifetime friendship. In particular they wrote the book *Lezioni di Controlli Automatici* (Siderea, Rome, 1963) which was to become a reference textbook for many students at Italian universities.

Soon Ruberti was appreciated by all colleagues for his technical and leadership skills. In 1969, he founded the *Istituto di Automatica* at the University of Rome. There he held many positions of responsibility. In particular, in 1976 he was elected Rector Magnificus. He held that position until 1988 when he became Minister of the Scientific Research of the Italian Government. In this new role he reformed the university system. Antonio Ruberti devoted his last years of activity to the European Union as Commissioner for Science and Research. A picture taken at his *Lectio Magistralis* of November 8, 1999 is reproduced in Fig. 14. On the occasion of what would have been his 80<sup>th</sup> birthday, a meeting on *University and Research; the Vision of Antonio Ruberti* was organized at the *Accademia Nazionale dei Lincei* (Rome, January 24<sup>th</sup>, 2007). The meeting took place in the presence of the President of the Italian Republic, Giorgio Napolitano.

■



Fig. 12 - The prestigious Quazza medal of IFAC (left, sculptor Tamás Vigh) and the plaque in the memory of the 25<sup>th</sup> anniversary of Giorgio Quazza death (right, sculptor Luigi Teruggi)

Some among the above mentioned scholars can be seen in their young days in Fig. 15. This is the famous “picture of the bench”. It was taken by Fabio Saccomanno (emeritus professor at the University of Genoa) on September the 12<sup>th</sup>, 1963, in Bressanone, a town where Italian control scientists met for their annual meetings and for their summer schools in the ‘60’s. From the left one can see Antonio Ruberti, Emanuele Biondi, Giorgio Quazza, Antonio Lepschy.

This picture gives me the opportunity to mention another distinguished Italian pioneer, Emanuele Biondi (born 1928). One of the first professors of Automatic Control in Italy, for 20 years from 1971 he directed Milan’s *System Theory Centre*, a Centre of the *National Research Council* hosted in the institute which nowadays has become the *Department of Electronics and Information* of the *Politecnico di Milano*. This centre played a main role in order to set up the appropriate framework for a number of young talents working in systems and control, bio-medical engineering, economics and environmental sciences. More details on the evolution of this centre will be given in the next section.

## 4 Italian institutions and research coordination

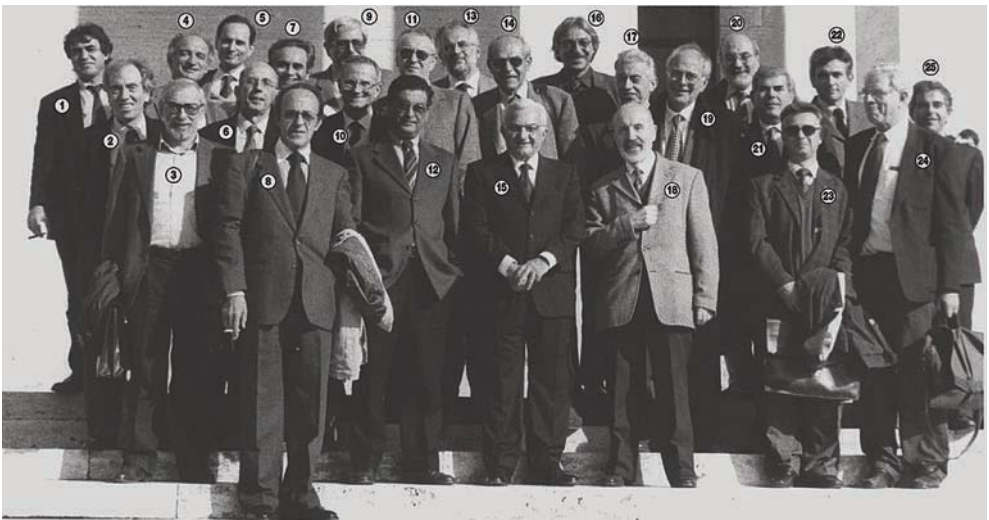
### 4.1 The role of the National Research Council of Italy, and other public institutions

Since the days of the celebrated *Convegno* of 1956, the National Research Council of Italy has played a major role in the promotion of research in control systems and automation technology. Many were the young graduates who started their career as CNR researchers, and are now internationally well known distinguished scientists.



1 A. Guazza 2 G. Diani 3 E. Gatti 4 G. Abbate Daga 5 M. Abram 6 N. Schiavoni 7 G. Conca  
 8 P. Bolzern 9 L. Gorni 10 P. Colaneri 11 P. Dorato 12 S. Bittanti 13 L. Capetta 14 F. Frigeri  
 15 G. Santagostino 16 N. Quazza 17 G. Quazza 18 U. Di Caprio 19 O. Crisalle  
 21 M.R. Tiramani 22 G. Menga 23 G. Manzoni 24 E. Canuto 25 Tangül Başar 26 A. M.  
 Kokotovic 27 Tamer Başar 28 G. Guardabassi 30 P. Kokotovic 31 A. Anderloni 32 D. Lucarella  
 33 F. Saccomanno 34 S. Guazza 35 A. De Marco 36 L. Folcini 37 C. Maffezzoni  
 38 V. Kucera 39 R. Meda 40 S. Corsi 41 P. Mirandola 42 E. Biondi 43 G. Baric 44 G. Garbossa  
 A. Quazza is the sister of Giorgio Quazza, N. Quazza his wife, G. and S. Quazza the daughters.

*Fig. 13 - The picture was taken immediately after the Quazza memorial, Milano June 26, 2003 (photo by Fabio Previdi and Sergio M. Savaresi)*



1 G. Bartolini 2 R. Zoppoli 3 M. Milanese 4 G. Di Pillo 5 R. Genesio 6 A. Isidori 7 G. De Maria  
8 L. Sciacivco 9 G. Guardabassi 10 O. M. Grasselli 11 C. Bonivento 12 C. Bruni 13 R. Minciardi  
14 G. Corriga 15 A. Ruberti 16 G. Casalino 17 A. Balestrino 18 A. Lepschy 19 T. Leo  
20 G. Koch 21 R. Guidorzi 22 S. Monaco 23 G. Conte 24 S. Nicosia 25 L. Fortuna

*Fig. 14 - A group of participants in the Lectio Magistralis given by Antonio Ruberti in Rome, November 8, 1999. The picture features a large group of Italian control scientists attending this last lecture of Professor Ruberti, who was born in 1927 and died in 2000 (photo by Sergio Bittanti)*



Fig. 15 – Four scholars on a bench – Bressanone, 1963.  
From left Ruberti, Biondi, Quazza, Lepschy (photo by Fabio Saccomanno)

Since 2002 the CNR has been re-organized. Previously, there were some three hundred CNR institutions in Italy. The new reform led to the reduction of the number of institutions to about a hundred and to their grouping into 11 Departments.

If we go back some 40 years, we see that the CNR organizations after the reform of 1968-69, were classified into these categories: *Institutes*, *Laboratories*, *Centres* and *Groups*. The *Institutes* were independent and permanent research institutions with a remarkable number of researchers. The same concept is used for these organizations even today. The *Laboratories* had also an independent position but they were set up for a limited duration of 10 years at the end of which they could possibly be transformed into Institutes. As for the *Centres*, they were smaller organizations with a relatively low number of researchers embedded in non-CNR institutions considered the most appropriate ones for advanced research on certain subjects. Normally a Centre was operating within a University. Finally the *Groups* were CNR organizations operating jointly with University research teams. Towards the end of '90's the CNR decided to dismantle the Centres.

Herein, I will mention the following CNR organizations, whose development is strictly tied or related to the evolution of control science and automation technology in Italy. Of course these notes reflect my own experience and view, and I cannot claim completeness. My apologies for possible omissions.

I begin with three organizations established in the early '70's which had a remarkable role in the growth and diffusions of systems and control ideas in Italy. They are listed in alphabetical order of their locations: Milan, Padua and Rome.

*Centre for the study of Systems Theory (Centro per lo studio della Teoria dei Sistemi - CTS)*

On the initiative of Emanuele Biondi, this Centre was established with an ordinance of the President of CNR dated August 11, 1971, within the Politecnico di Milano. This was the period where optimal control ideas and the revolutionary state-space approach had the most impact. In the Centre expertise in different areas was combined to new research areas covering a broad scope, from system theory to operation research, from control to environmental studies, not to mention the economic applications. Many young and enthusiastic researchers started their careers in positions offered by the CNR Centre, and CTS soon became a convergence point for interdisciplinary research. The situation had to change with the rise of new departments in the Politecnico di Milano. In particular, the foundation of the new Department in Biomedical Engineering, with the parallel creation of the CNR *Centre for the Study of Biomedical Engineering* hosted in the new Department, had as a natural consequence that many CTS-CNR researchers moved to that Department. Moreover, a new Department of Economy and Management was created, and this removed another traditional research line from the CTS. This led to a change in the background of the scientific activities taking place in the Centre. In 1991, the direction of the Centre passed from Emanuele Biondi to Arturo Locatelli. In 1997 it was decided to create a new Centre for the study of computer and control (with the acronym CESTIA) as a merger of the CTS and a Centre devoted to computer engineering operating in the same Department of the Politecnico di Milano. Later on, the CNR underwent a re-organization leading to the abolishment of all Centres. Nowadays, the CNR researchers hosted in the *Department of Electronics and Information* are affiliated to the *Istituto di Elettronica e di Ingegneria dell'Informazione e delle Telecomunicazioni* (IEIIT Institute) of the CNR, an institute which is part of the ICT Department.

*Laboratory for Research on System Dynamics and Biomedical Electronics (Laboratorio per Ricerche di Dinamica dei Sistemi e di Elettronica Biomedica - LADSEB)*

At the end of the '50's, the CNR National Group for Electronics and Telecommunications was active in Italy. It was organized in various Sections. Giuseppe Francini, the first professor of Applied Electronics in Italy, was heading a Section of this Group. In this Section, located in Padua, studies on automatic control began in cooperation with the School of Engineering of the University of Padua. As a consequence of this activity, in 1968 the CNR established in Padua the *Laboratory of Biomedical Electronics (Laboratorio per l'Elettronica Biomedica - LEBM)*, under the direction of Francini, and in 1970 the *Laboratory of Industrial Electronics (Laboratorio di Elettronica Industriale LEI)* directed by Antonio Lepschy. In the latter lab the first studies were devoted to the development of digital technologies with focus on identification and optimization methods for process control. In 1973, *LEBM* and *LEI* merged into a unique organization, the *Laboratorio per Ricerche di Dinamica dei Sistemi e di Elettronica Biomedica - LADSEB*, under the direction of Lepschy. The laboratory moved to a new area in the surroundings of Padua in 1975. Then the direction passed to Luigi Mariani, and subsequently to Rosanna Degani (since 1990 until her premature death).

The main thrust of the new Institute was in the field of stochastic systems theory and its applications to control and bioengineering. Tight collaborations with international

leading experts in the fields of stochastic systems and biomedical modeling helped to create an active team of young researchers. In 2002, CNR underwent another reform and LADSEB merged with the Centre of Bioengineering (CIB) of Milan. This gave rise to the new *Institute of Biomedical Engineering (Istituto di Ingegneria Biomedica ISIB)* as part of the Medicine Department of CNR. Despite the name and affiliation change, the research on the theoretical aspects and practical applications of mathematical modeling, in the spirit of its old days, is still one of the main activities of the Institute.

*Centre for the Study of Control Systems and Automatic Computation (Centro di Studio dei Sistemi di Controllo e Calcolo Automatico - CSSCCA)*

Thanks to Antonio Ruberti, the *Centre for the Study of Control Systems and Automatic Computation* of the CNR was established in December 1970 at the *Istituto di Automatica* in the University of Rome “La Sapienza”. Its mission was the study of complex automatic systems, with focus on the following topics: (i) models and methods for the analysis, identification, optimization and computerization of control systems for plants and services; (ii) models and methods for the analysis and design of systems in the field of software engineering by also taking into account the related hardware issues; (iii) applications to bioengineering. In the first years, the centre activities fully relied on the existing expertise available at the *Istituto di Automatica*. At the end of the ‘70’s strong methodological skills had been developed in the centre. It had reached such remarkable dimension and international reputation that it was transformed into an independent autonomous structure. In November 1980 the *Istituto di Analisi dei Sistemi ed Informatica (IASI)* of the CNR was founded, in order to study the theory of systems and control, optimization methods, theoretical computer science and programming systems, data bases and information systems; economic and biomedical systems. This presence of many computer related research topics reflected the conviction of Ruberti that for control to reach its full potential it had to take full advantage of the progress in computer sciences and computer engineering. While the Centre was directed by Antonio Ruberti for the full decade of its existence, the IASI direction was entrusted to Lucio Bianco, with Ruberti serving as President of the Scientific Council. The Institute is currently directed by Giovanni Rinaldi, and is still very active on methods of computer science and systems analysis with more than 30 researchers. As a consequence of the reorganization of the CNR in 2002, the IASI is today affiliated to the ICT Department of the CNR. Since May 23<sup>rd</sup> 2001, after the death of Ruberti in 2000, the name of the IASI changed to *Istituto di Analisi dei Sistemi ed Informatica “Antonio Ruberti”*. ■

Coming to the CNR Institutes, we will mention the following ones.

*Institute of Industrial Technologies and Automation (Istituto di Tecnologie Industriali e Automazione - ITIA)*

In 1963, on the initiative of Ruggero Chiappulini, the CNR established the *Centro Macchine Utensili* (CEMU) in Milan to carry out scientific research and technological development to support the Italian machine tool industry. Chiappulini was the director until 1976, when the direction passed to Athos Palagi. Later in 1986, Francesco Jovane became director. The Centre became the ITIA-CNR Institute, expanding its activities to

various manufacturing sectors, covering enabling technologies concerned with new products, processes and business models. As a contribution to the competitiveness and sustainability of national and European manufacturing industry, ITIA-CNR has developed new generations of machines and robots, such as Parallel Kinematics Machines, as well as new pilot plants, in three manufacturing sectors. The Institute has also developed new tools for design, production, logistics.

As a part of the European and international RTD network, ITIA-CNR has been very active within European, national and regional projects, in cooperation with Universities, research Institutes and industry.

ITIA-CNR has promoted and carried out Strategic Studies ranging from the future of manufacturing to emergent technologies, within the project *New Technological and Industrial Revolution*. Thus, it has contributed to several national and European research projects, as well as technological platforms. The European *Manufuture* Platform, launched in Milano in 2003, is based on strategic studies carried out by ITIA-CNR. The mission of the *Manufuture* platform, involving 25 European countries, is to propose a strategy based on research and innovation, capable of speeding up the rate of industrial transformation in Europe, securing high added value employment and winning a major share of world manufacturing output in the future knowledge-driven economy.

#### *Institute for Naval Automation (Istituto per l'Automazione Navale - IAN)*

A naval automation team was established in 1965 at the Engineering School of the University of Genoa: in fact, the need of research work was deemed urgent for the application of modern techniques in shipyards, harbours and navigation. The CNR granted contributions and, in 1970, established in Genoa a national, specific organization (originally named Laboratory and, since 1980, Institute).

The original mission of this organization was presented in the December 1965 issue of the CNR scientific news "Informazione Scientifica": *Ship control must not be considered a collection of a number of solutions to several separate problems of automation and tele-control, but as an integration of solutions into a single framework.*

Many industries and project centres collaborated in this general programme. The first large experiment - named "Esquilino Project" - took place in 1969, setting up centralized measurements and controls on the Esquilino, one of the cargo ship of the Italian company Lloyd Triestino, which went in regular traffic between Trieste and ports in East Asia and Japan. The system was supervised from a central computer (in the beginning an IBM 1800, and subsequently a Selenia GP16). A first comprehensive presentation of the results obtained on this project was presented at the "International Symposium on Ship Automation" held in Genoa in June 1966 (with 30 papers, half of them by Italian authors). A number of further studies have been successively published and discussed in several symposia and conferences.

The IAN established a cooperation with several organizations, study centres and industries in Italy and Europe, such as the Port Authority of Marseilles, the University



of Barcelona, the DFVLR (research centre in Munich), the TNO in Delft. The main area of study included the preliminary investigations into the navigability of the Messina Strait during the possible construction of the bridge; the hydrofoils stability and further specific problems of navigation. Moreover IAN was very active in the European Project COST 301 "Aids to maritime navigation".

From its origins and up to 1990, the Institute has been directed by Ezio Volta of the University of Genoa. In 1990 Filippo Grassia became the director. In 2002 the IAN has been embedded in the ISSIA (*Istituto di Studi sui Sistemi per l'Automazione* – whose direction is in Bari).

*Institute on Intelligent Systems for Automation (Istituto di Studi sui Sistemi Intelligenti per l'Automazione - ISSIA)*

Following the recent reorganization of CNR, the Institute of Intelligent Systems for Automation (ISSIA) was founded in April 2002. The Institute is well known for its advanced expertise in intelligent systems and its spin-offs to industrial and social areas. These areas include (i) robotics, as evidenced in the development of intelligent machines capable of autonomously operating in unstructured and uncertain environments (ii) automation for increased performance, productivity and security of complex systems (iii) signal and image processing in the field of integrated hardware and software systems for the acquisition and processing of multi-spectral, multi-temporal and multi-platform information and (iv) systems for the support of decisions based on soft-computing in complex applications.

Studying and developing complex intelligent systems creates new scientific opportunities and inter-disciplinary themes of research in the field of computer science (elaboration of information), physics (optics and light-matter interaction), cybernetics (computational neural models), electric and electronic engineering (sensors, actuators, control, electrical driving, power electronics, electromagnetic compatibility), mechanic engineering, artificial intelligence, digital signal and image processing, robotics, automation, and operating research. The Institute is involved in several European projects, Italian projects and industrial grants for research activities.

*Institute of Cybernetics (Istituto di Cibernetica "Eduardo Caianiello"- ICIB)*

In 1968, thanks to the intuition of the theoretical physicist Eduardo R. Caianiello, the CNR decided to establish a new Institute in Naples, the Istituto di Cibernetica (ICIB). It was conceived as a follow up to the interdisciplinary research activities conducted in the '60's at the Institute of Theoretical Physics of the University of Naples. These activities focused on the study of the neural network model proposed in Caianiello's seminal paper "Outline of a theory of thought-processes and thinking machines" published in the *J. of Theoretical Biology*, Vol 1, 204-235 (1961). It is worth mentioning that, during the '50's and early '60's, Norbert Wiener was pleased to visit Caianello and his team, his longest visit lasting about one year in 1963. His figure is remembered while walking in the corridors smoking his cigar. The photograph of Fig. 16 was taken during one of the many stays of Wiener in Italy, at the *International School of Physics* held in Varenna in July 1958.



*Fig. 16 - The group of participants in the International School of Physics held in Varenna in July 1958. Norbert Wiener in the centre*

The hardware model of the above mentioned neural network was developed at the Institute and named DIANA (a synthesis of Digital and ANALogical). The researchers were also working on related issues, such as superconducting devices (Josephson junctions) which were considered in those days as “artificial models of the axon”.

Presently, the mission of the Institute is the development of interdisciplinary technologies starting from fundamental research. This institute involves about 70 researchers and focuses on the physics of coherent systems and distributed information systems. As for the technological transfer, it is worth mentioning the spin-off SIRIS (Servizi Integrati di Rete per l'Industria e la Scienza) developing systems for the dissemination of Italian cultural heritage, the participation of Fluxonics (The European Foundry for Superconductive Electronics) as well as the use of superconducting devices in medical instruments (magneto - cardiography and encephalography).

*Institute for Electronics, Engineering, Information and Telecommunications (Istituto di Elettronica e di Ingegneria dell'Informazione e delle Telecomunicazioni - IEIIT)*

The IEIIT (Institute for Electronics, Engineering, Information and Telecommunications) was founded in 2001 by the National Research Council merging five existing units in Bologna, Genova, Milano, Pisa and Torino. The headquarter of IEIIT is located at Politecnico di Torino, and it has a permanent staff of about sixty researchers, technical staff and administrative personnel. Research at IEIIT is very broad and productive, cov-

ering all areas of Information and Communication Technology, including antennas and propagation, communications and networking, computer engineering, signal processing, systems and control.

The unit of IEIIT located at Politecnico di Torino originated from a previous CNR Institute, named IRITI, which came into existence in 1999 from the merger of the CNR centers CENS, CESPAs and CSTV which had been very active in the area of electrical engineering. CENS (Center for Signal Processing) and CESPAs (Center for Antennas and Propagation) were founded in 1970 by CNR and Politecnico di Torino. CSTV (Center for Broadcasting and Television) was originally established in 1949, based on a joint agreement between CNR, IENGF (National Institute Galileo Ferraris) and RAI (Italian Public Broadcasting Corporation). In 1971, the center CSTV was reorganized using a revised agreement between CNR and IENGF.

In the early seventies, the research activities at CENS were focused on developing hardware and software for signal processing, with specific attention to speech recognition. Subsequently, these activities expanded to other areas within electrical engineering. In particular, computer architectures and networks together with system identification and control played a prominent role at CENS for many years. Currently, these fields of research constitute one of the focal points of activities at IEIIT.

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Among the various initiatives involving the CNR on control research, I would also like to mention, the *Project on Advanced Research of Architecture and Design of Electronic Systems European Group of Economic Interest (PARADES EEIG)*. It was launched in 1996 by Alberto Sangiovanni Vincentelli, with Cadence, Magneti Marelli and ST Microelectronics as shareholders and CNR as an associate member. To be precise, the CNR supported the formation of PARADES by providing in-kind contributions ranging from equipment to infrastructural services. By taking advantage of its role as a link between the industrial and the academic/research worlds, PARADES activities are concerned with creating frameworks for efficient design solutions for distributed control of networks of embedded systems with emphasis on automotive systems. The whole design process is studied from system conceptualization to HW/SW architecture definition and constraints on costs, performance and dependability are also taken into account.

Finally, I would like to mention the activity developed at the CNR *Institute for the Applications of Computation "Mauro Picone" (Istituto per le Applicazioni del Calcolo "Mauro Picone" IAC)*. This institute, founded in 1927 by Mauro Picone, has been reorganized in 2002 and is now located in Rome, Bari, Florence and Naples. Its goal, carried out by a scientific staff of about 55 researchers, is to develop highly advanced mathematical, statistical and computational methods in order to solve, in a mostly interdisciplinary context, problems with strong relevance to society and industry. A new line of research in control started in 2001, with hybrid and quantized control, embedded and networked systems, control of flows on networks, and bio-medical applications as the main research themes.

The CNR has also promoted a series of volumes on Control Science denominated *Collana di Automatica*. The series is composed of these books:

Vol. 1 - Problemi attuali di teoria dei controlli automatici (Current problems of automatic control theory). CNR, Rome 1965.

Vol. 2 - Identificazione e ottimizzazione (Identification and optimization). CNR, Rome 1967.

Vol. 3 - I processi stocastici nei controlli automatici (Stochastic processes in automatic control). CNR, Rome 1970.

Vol. 4 - Identificazione dei sistemi stocastici (Identification of stochastic systems). CNR, Rome 1978.

Actually, these volumes are the proceedings of summer schools jointly organized by teams of researchers at Italian universities. They took place in Bressanone (1963, 1964, 1965), Cagliari (1966) and Palermo (1977).

This book is Vol. 5 of the *Collana di Automatica*.

Last but not least, the CNR is the Italian institution responsible for the Italian connection with IFAC, and it pays the annual fee.

Many further public institutions have played a significant role in the development outlined in my overview. In particular, I have on several occasions mentioned the *Fondazione Bordini*, about which I will now say a few words.

*Ugo Bordini Foundation (Fondazione Ugo Bordini - FUB)*

The Italian Ministry of Post and Telecommunications established in 1928 the *Istituto Superiore delle Poste e Telecomunicazioni (ISPT)* with the objective of creating a centre of competence in the growing area of telecommunications technology. The ISPT activities were oriented towards both education and engineering research in telecommunications and related areas. One particular activity was to support the technical certification of electronic apparatus for civil applications and domestic use. The first director was Orso Mario Corbino, a prominent figure in physics, director of the Physics Department at the University of Rome and mentor of Enrico Fermi. The ISPT is still operating in our days.

After World War 2, the creation of public telephone companies for local and long distance services stimulated the establishment in 1952 of the *Fondazione Ugo Bordini (FUB)*, a research foundation with the objective of performing research in the growing electronic technology areas of both telecommunications and the sister branches of computers and automatic control. The FUB was supported both by the ISPT, that offered infrastructure and laboratory facilities, and by the public telephone companies that contributed to the funding in the form of a given percentage of their annual revenues. The first President of FUB was Algeri Marino, professor of Electrical Communications at the

University of Rome, and former General of the *Genio Aeronautico* (the technical branch of the Italian Air Force). The FUB laboratories were formed and supervised by the researchers and professors of the University of Rome and other major universities.

The *Fondazione* has since the beginning been a real incubator for research in communications and control sciences, and from the late '60's also an incubator for research in computer science. In the '50's and '60's the research activities were run by Bruno Peroni in communications, by Antonio Lepschy and Antonio Ruberti in automatic control, and by Giuseppe Francini and Daniele Sette in electronics and photonics. The research in Computer technology was mainly carried out by Mauro Picone and Roberto Vacca at the INAC (*Istituto Nazionale Applicazioni del Calcolo*, National Institute for Computing Applications).

Throughout the '90's the FUB has preserved the original mission and the funding by a fixed percentage of the revenues of the public telephone companies. FUB has maintained a respected technical competence, and has progressively focused activities both on telecommunications equipment and services, and on synergies with various universities, CNR Institutes, Italian Ministries and European Research organizations.

In 1994 the various Italian public Telephone Companies were finally integrated into a single one, Telecom Italia, in preparation for the telecom market liberalization of 1997. After a transitory period, in 2000 the FUB was re-established as a non-profit private institution of high cultural value, and the funding is provided by many representatives of the telecom industries. Today's FUB mission is primarily focused on advising the Ministry of Communications, about possible development strategies for Italy as a country in areas such as telephony, television, Internet, wireless communications, information and network security, and technologies for disabled.

#### **4.2 Coordination of control research**

The research activity in systems, control and automation has always developed in a collaborative, friendly and informal framework.

The CNR had the merit of providing an appropriate research coordination framework, characterized by a negligible level of bureaucracy. Originally, such coordination took place via the so called *CNR Group of Researchers of Automatica* (*Gruppo dei Ricercatori di Automatica - GRA*). This Group was founded in 1969; its name changed in the subsequent years according to the specific academic trends of the periods. In 1980, a new reform of the university system (known as DPR 382/80) led to the creation of the *Interuniversity Centres*. The researchers then re-organized under the umbrella of the *Interuniversity Centre of Research in Automatica* (*Centro Interuniversitario di Ricerca in Automatica - CIRA*). This Centre has been active until 2006, when a new association, called *SIDRA* (*Società Italiana dei Docenti e Ricercatori di Automatica - Italian Society of Professors and Researchers of Automatica*) was founded. The formal act of the SIDRA foundation was signed on September 19<sup>th</sup> by notary De Marchi in Milan, during the last CIRA meeting (2006 at the Politecnico di Milano). This association will take over the coordination task in the years to come.



1 Murgo 2 Biondi 3 Corriga 4 Barozzi 5 Quazza 6 Policastro 7 Saccomanno 8 Divieti  
9 Mariani 10 De Carli 11 Marchesini 12 Lepschy 13 Marzollo 14 Ruberti 15 Petternella  
16 Lugli 17 Raimondi 18 De Julio 19 Florio 20 Donati 21 Milo 22 Vicinanza 23 Grasselli  
24 Ciscato 25 Righi

*Fig. 17 - A group of participants in the Bressanone meeting of 1963*

Already in the '60's the community of Italian researchers started to meet for informal research exchanges. The first meetings took place in the town of Bressanone, in 1963 (see Fig. 17), 1964 and 1965. During these meetings a summer school devoted to the discussion of emerging topics was organized by lecturers of various universities, in a joint coordination effort. The school was open to all interested young and less young researchers. This series of events was continued in 1966 in Cagliari. After this meeting, this initiative of a summer school was not repeated, and one has to pass to 1977 to find a similar event, this time in Palermo.

As already pointed out, the lectures presented in these meeting were collected in 4 books published by CNR in 1965 (collecting the lectures given at the Summer School held in Bressanone in 1964), 1967 (Summer Schools of Bressanone of the years 1965 and 1966), 1970 (Summer School of Cagliari) and 1978 (Summer School of Palermo). These volumes, constituting the *Automatica series* of the CNR, were a main reference source for the incoming generations of control enthusiasts entering universities and research organizations in those years. The cover of the first volume is reproduced in Fig. 18.

For some period after the Palermo meeting, no national scientific gathering was organized. It reappeared again in the middle of the '80's, when we started organizing an annual meeting named *Identification, Control and Optimization of Dynamical Systems*. The first of these workshops took place in June 1984, and repeated for the next 4 years, always in the same location, namely at Villa Olmo, Como. These meetings were originally conceived as a coordinated activity of two projects funded by the Italian Ministry of University and Research, namely the project *Metodologie e Dispositivi per l'Identificazione, il Controllo e l'Ottimizzazione dei Sistemi Dinamici* and the project *Teoria del Controllo e Ottimizzazione dei Sistemi Dinamici*. The poster of the first meeting of 1984 is reproduced in Fig. 19, where the full list of speakers can be seen. In that occasion, we invited R.E. Kalman, who gave a inspiring lecture on *New Theory of System Identification from Noisy Data*.

With the years passing more and more research projects joined this initiative. In the long run it became the annual Italian meeting of all research teams in systems, control and automation. As a consequence it became known as the "CIRA meeting". As mentioned above the CIRA coordinated the research activities in automatica for about a quarter of century starting in 1980. After the first workshops in Como, the national coordination workshops were held in different locations. Ever since it has been held regularly on a yearly basis, in the month of June or September. In 2006, the CIRA meeting took place on September 16 -18 at the Politecnico di Milano. The second *Convegno Internazionale sui Problemi dell'Automatismo* was so-to-say embedded in it, being held on the afternoon of September 18<sup>th</sup>.

The above remarks on the meetings taking place at Villa Olmo lead me to express a word of appreciation for the praiseworthy activity of the *Centro di Cultura Scientifica A. Volta*, operating in Villa Olmo since 1983. This Centre, promoted by Como municipality, Provincial Administration and Chamber of Commerce, as well as by Lombardy Region and Comune di Campione d'Italia municipality, is an altogether original organization in



Fig. 18 – Cover of the first volume of the Automatica series published by the National Research Council of Italy (CNR)



Fig. 19 – The announcement of the meeting Identification, Control, Optimization of Dynamical Systems of 1984



both the Italian and international scene, that combines an intense activity in organizing scientific conference and seminars, with a liaising function between the academic and research worlds and the underlying cultural, economic and social substrates of the area. Many events in the field of systems, control and automation have been made possible thanks to this centre. Among many, I would like to mention first the workshop on *New Horizons in Systems Theory* organized in May 1986. Other events in chronological order were: Workshop on the *Riccati equation in Control, Systems and Signals* (June 26–28 1989), sponsored by CNR, IFAC, IEEE, SIAM; NATO Advanced Study Institute *From Identification to Learning* (August 22–September 2, 1994); IFAC Workshop on *Periodic Control Systems* (August 27, 28, 2001); IFAC Symposium on *Adaptation and Learning in Control and Signal Processing* (August 29–31, 2001); IEEE/ASME International Conference on *Advanced Intelligent Mechatronics* (AIM 01) (8–12 July 2001).

The CIRA meetings had the form of small informal congresses for the presentation and dissemination of the latest research findings achieved in this or that project of research. However, the tradition of research schools, which goes back to the Bressanone workshops, had not been lost. Indeed, an annual school for Ph.D. students is now provided each year. In this regard it is worth mentioning that the Ph.D. Program of Studies was started in Italy in the academic year 1983–84. Previously, Italians who were interested in higher degree education had to move abroad. For example, as already mentioned, Giorgio Quazza received his Ph.D. at the Brooklyn Polytechnic Institute. The establishment of the Ph.D. Program revitalized the summer schools organization as a joint effort of the various research teams in automatica. Since 1997, under the coordination of Giovanni Marro, professor in Bologna, and Lorenzo Sciavicco, professor at the Third University of Rome, these schools take place annually in a small and nice citadel located on the top of a hill in the town of Bertinoro.

As already said, during the CIRA meeting of 2006 the formal act of the creation of a new society, SIDRA, was signed. Hence the annual meetings to be held will be named *SIDRA meetings* and the Ph.D. schools of Bertinoro will be named the *SIDRA schools* in the coming years.

## 5. Control developments - reflections after 50 years

Have the original expectations from 1956 come true? Which developments can be expected in the forthcoming decades?

### 5.1 Theoretical developments

In the span of a few years, Norbert Wiener, professor at M.I.T., wrote a series of books which were to mark the mid XX-th Century: *Cybernetics* (1948, with a second enlarged edition published in 1961), *Extrapolation, Interpolation and Smoothing of Stationary Time Series* (1949) and *The Human Use of Human Beings* (1950). These books presented the notion of a cause–effect system in terms of a dynamical relationship from input to output signals, as a conceptual unit independent of the background field where the

system came from. Initially this general view was given an operative shape by means of transfer function representations based on Laplace- or z-transforms. However, with the new filtering and control problems posed by the development of technology, especially in aerospace remote control, it soon became apparent that these tools were not sufficient to provide a complete answer.

After many dead ends, the rise of optimal control methods and state-space techniques in the '60's and '70's raised the curtain for a new world. With this huge enlargement of the conceptual framework, the walls within which control was confined were demolished. This attracted the enthusiastic interest of many outstanding young minds. The mathematics of Kalman filtering and LQG control became the banner of this revolution.

Meanwhile, system identification developed in subsequent waves. This area, still in evolution, deals with finding mathematical descriptions of real world phenomena using experimental data. This is not a new matter. A cornerstone example can be traced back to the discoveries of the XVII-th and XVIII-th centuries leading to the compression of astronomical phenomena into an elementary mathematical formula. Giving credit to Galileo, according to whom "the book of nature is written in mathematical terms", one can of course pose the general question whether such a success can be extended to *any* phenomenon in nature. In turn, this poses a fundamental problem, the extent of predictability of phenomena. At one extreme is the belief that the future is fully written in the past: "Events in the future don't pop out unexpectedly: as the uncoiling of a rope is the passage of time, nothing new is created but rather unfolded from the old" (Cicero, *De Divinatione* I, 127: *Non enim illa quae futura sunt subito existunt, sed est quasi rudentis explicatio sic traductio temporis nihil novi efficientis et primum quidque replicantis*). According to this view, prediction-with-no-error is in principle possible, provided that the causal law which determines the future from the past and captures it in mathematical terms is unveiled. This seems to be the case for the motion of celestial bodies; indeed with high precision we can tell the position of a planet in the universe at any time; so one can say today where Saturn will be located on January 7<sup>th</sup>, 2717 or where it was positioned on the day when Julius Caesar came to life. In our days, however, we have seen that solid mathematical theories can also be worked out on the basis of "prediction-with-error" descriptions. This sort of "genetic mutation" in the mathematical thinking is one of the marks of the scientific developments in the XX-th Century: the more humble concept of a *model* seems to prevail over that of a *law*. System identification is a paradigm of the art of modelling-with-error. Its developments enabled the application of mathematics to many new real world problems; in particular it freed the designer from the heavy task of constructing a model of the process from first principles prior to control synthesis.

## ***5.2 Convergence between the abstract and the real world***

Following the enthusiasm raised by the state-space revolution in the '60's, the focus of activities in universities has been mainly oriented towards theoretical work. In the '60's and '70's, many mathematical methods were used on different control problems,

leading to a huge literature in the best journals of the field. In the long run, some control engineers had the feeling that the real world control problems were neglected by control academicians. It seemed as if new theories had to find applicability only in very advanced technological areas, or no applicability at all. This had attracted the interest of mathematicians; however it had a negative side-effect on engineering schools, where control was seen as a discipline confined in the walls of pure methodology. Some control journals, published by renowned engineering societies, were progressively seen as publications of pure mathematics, and perhaps not of the best level. The “control problems” dealt with were clearly academic exercises finalized in the publication of a further paper. As Jan Willems writes in his essay published in [3], “I have always felt uncomfortable with the distance between mathematics of control and the physical reality which it aims at”.

As time went by, it seems to me that this situation has changed slightly. In my experience, matured over some decades of work in an engineering school, one can now recognize a cross-fertilization between theoretical and applied work. Moreover, there are now many more areas where control is vital. The interest of companies for interaction with universities has increased remarkably. This collaboration has been facilitated by the impressive progress in microelectronics, with the availability of increased computing power at low cost. This has made it possible to implement complex control strategies derived using abstract methods.

Besides the classical fields of process control, power systems and aerospace guidance, we have more recently seen an impressive list of novel applications, such as automotive control systems, robotics and mechatronics, to name just a few areas in engineering. As everyone knows in a modern car one already has many embedded control systems, and many more will be installed in the next decades. But we should not forget the interplay with areas such as biology, genetics and neuroscience. In this respect, it is worth mentioning that there are many scientists who think that a malfunctioning in the regulation system is a key to understanding the deterioration of genetic mechanisms leading to the development of the cancer.

On the top of this, in the global competitive world where our offspring will live in, the need for innovation is more and more evident to industries. And no doubt control can significantly contribute to innovation. This way, the gap between theory and application is significantly reduced. Control, the *invisible technology* or, quoting Karl Åström, the *hidden technology*, is emerging from the darkness in which it has been enwrapped for so many years.

For a recent overview of the main topics in current research the reader is referred to the *milestone reports* of IFAC prepared for the World Congress of Prague, 2005, published in [7]. The contribution of Italian researchers is witnessed by the participation in major international conferences. For instance, among the papers presented at the *IFAC World Congress* held in Prague in July 2005, there were as many as 414 Italian authors. This number was surpassed only by France (521 authors) and USA (449 authors). Analogously, at the joint *IEEE Conference on Decision and Control and European Control Conference (CDC-ECC)* of Seville (December 2005) one can count 967 US authors, 412

French and 349 Italian. For comprehensive historical reports on the development of control in Italy see the papers by Toni Lepschy, [8] and [9] (in Italian), and by Guido O. Guardabassi in [10] (in English).

### 5.3 University education

At the end of his opening speech of the congress of '56, the President of CNR Gustavo Colonnetti underlined the need of creating new specialists in automation:

*“.... l'automazione impone una sempre maggiore specializzazione dei tecnici che vi attendono; di qui la necessita' di piu' profonde riforme, sia nell'istruzione universitaria, sia nell'istruzione professionale che va potenziata ed estesa in misura adeguata ...”*

*“.... automation requires an increasing specialization of involved technicians; hence, we believe that there is a need of deeper reforms, both in high school and university education, in order to reinforce and extend it in a suitable way...”*

50 years have been necessary to transform this wish into reality. Indeed, at the turn of the millennium many Italian universities started a new curriculum entirely devoted to automatic control, and in 2006 we have seen the first master graduates in this new type of university course. Colonnetti's wish has come true.

## 6. The second “Convegno”

The meeting of September the 18<sup>th</sup> was constituted by:

- A) Messages from authorities and welcome addresses
- B) Invited lectures
- C) Round table

The messages from authorities included

Telegram from the Presidency of the Italian Republic  
Fax from the President of Region Lombardy  
Telegram from the President of the National Research Council (CNR).

The welcome addresses were presented by  
Giulio Ballio, Rector Magnificus of the Politecnico di Milano  
Francesco Beltrame, Director of the *Information and Communication Technology Department* of the CNR, on the behalf of the President of CNR  
Sergio Carrà, professor at the Politecnico di Milano, on the behalf of the President of *Accademia Nazionale dei Lincei*

Emilio Gatti, professor at the Politecnico di Milano, on the behalf of the President of *Istituto Lombardo Accademia di Scienze e Lettere*.

The invited lecturers were:

*Sergio Barabaschi*, who took part in the *Convegno* of 1956 and therefore is an *eye witness* to our beginnings. He gave a lecture on the dawn of automatic control in Italy. Thanks to his long career in control laboratories and in Italian and European scientific institutions, he is in a unique position to overview many of the seminal events behind the formation of a control community with its own identity.

*Graham C. Goodwin*, professor at the University of Newcastle, Australia, is well known for his contributions to several areas of control and is the recipient of many international prizes. He presented an inspiring essay on the past, present and future of digital control, by taking inspiration from his own personal experiences in industrial projects. He pointed out the potential of control technology far beyond its traditional borders.

*Hidenori Kimura* After years of service at the Osaka University and other universities, he is now the team leader of the Laboratory of Biological Control Systems, Biomimetic Control Research Center, The Institute of Physical and Chemical Research (RIKEN). His current research interest is clarification of fundamental design principles of biological control in layered architecture of living organisms. He gave a profound lecture on control problems in life sciences.

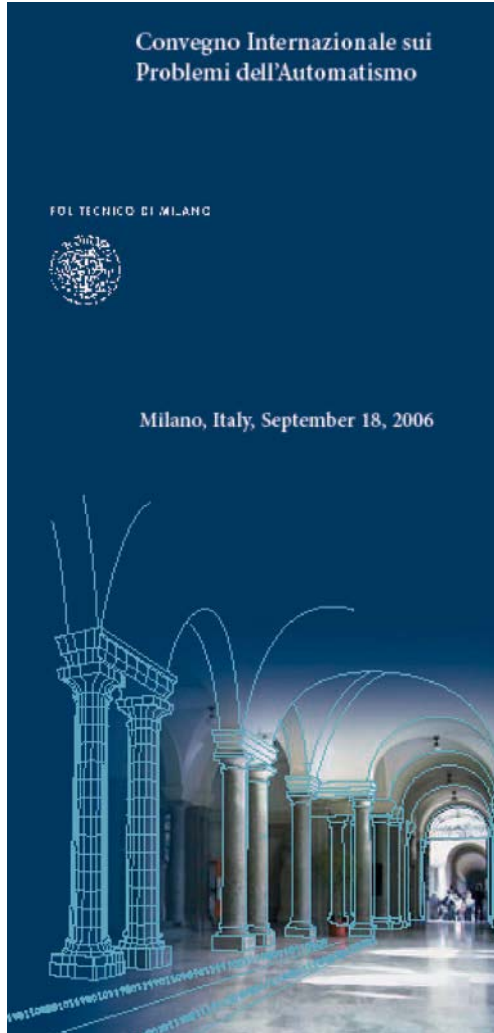
*Giovanni Marro* Professor at Bologna University. He is one of the leading personalities of the Italian control community. He is known as the initiator of the system theoretic geometric approach to control problems, and his essay is a very comprehensive tutorial presentation of the results obtained in the field throughout his research life.

The Panelists of the round table were:

- L. D'Alessandro, President of ANIPLA (*Associazione Nazionale per l'Automazione*)
- A. Skoff, representing the President of AEIT (*Associazione Nazionale di Elettrotecnica, Elettronica, Automazione, Informatica e Telecomunicazioni*)
- A. Vicino, President of CIRA (*Centro Interuniversitario di Ricerca in Automatica*)

Among the various topics discussed we mention the perception of automation in the industrial world.

The *Convegno* was held in the Room S01 of Politecnico di Milano, beginning at 14:30 on the 18<sup>th</sup> of September; the final round table closed around 19:30. The room was full of attendees, with people standing in the corridors. The announcement of the meeting is reproduced in Fig. 20.



*Fig. 20 - The leaflet announcing the Second Convegno Internazionale sui Problemi dell'Automatismo*

## 7. The day that will come

In the last decades new scientific disciplines came to the stage, some of which had already a major impact. Control Science is one of them: although automatic control systems have been operating in various types of machines and devices at different periods of human civilization, only in second half of the XX-th Century control became an autonomous discipline leading in a matter of few decades to the development of formidable tools to solve problems of our times. One convincing example is the reduction of the pollution produced by internal combustion automotive engines, passed from 0.14 g/km particulate matter emission in 1992 (Euro 1, according to European regulations for diesel cars) to 0.005 g/km in 2009 (Euro 5). No doubt control played a central role in that progress.

Many more developments will take place in the years to come. Some stimulating directions are discussed in the forthcoming essays.

There still are many objectives to be achieved, and they will be an exciting subject of research for future generations. We can take for granted that the youngest in the audience will contribute to them and see the advances in their everyday life.

For the world-wide advances in the coming half Century, we refer the youngest readers to the third *Convegno Internazionale sui Problemi dell'Automatismo*, to be held in 2056. In the short run, our readers may consider some major events such as the next IFAC World Congress, to be held in 2011 in Milan.

As for the Italian perspective, I would like to mention that in his opening speech of 1956, Gustavo Colonnetti's, then President of the CNR, formulated two auspices concerning automation in Italy. One, already quoted in Section 5.3, concerned with the need for a university course entirely devoted to automatic control. This has recently been achieved with the creation of a specific degree, so that 50 years after Colonnetti's speech, we see the first Italian master graduates in control.

The second one is extensively dealt with in the final part of his speech:

*From my previous considerations, I would like to conclude that it is necessary to create a National Centre for Automation, so as to tackle and solve the numerous scientific, technological, and application oriented problems, of an economic, financial and social type.*

Concerning this last statement, observe that in the '50's computer science was still in its infancy, at least in Italy. A decade later or so, the scenario was progressively changing and the synergy between computerized information processing and automatic control methods became more and more apparent. This new framework became mature around the late '60's leading to the creation of new national institutes. The case of France is worth mentioning. The INRIA (*Institut National de Recherche en Informatique et en Automatique*) started to operate in 1972. It was the natural evolution of IRIA (*Institut de Recherche d'Informatique et d'Automatique*) which was created in 1967 "pour conduire une réflexion sur l'importance des nouvelles techniques du traitement de l'information" (in order to reflect on the importance of new techniques for the processing of information), as one can read on the INRIA web site. The mission of INRIA is very close to the spirit of Colonnetti's vision. A similar institution has not been realized yet in Italy. We wonder whether, the National Center foreseen by Gustavo Colonnetti will come true within the coming half Century.

## Acknowledgements

I had the privilege to meet distinguished pioneers of control who are no longer with us. In particular I would like to pay tribute to the memory of Giorgio Quazza, who was taken from us too early. I still remember being a timid assistant of him at the exams in Process Control in the 1970's.

This paper benefited by the discussions and suggestions of many scholars. Among others, I would like to homage to the memory of Professor Antonio (Toni) Lepschy, who passed away on June the 30<sup>th</sup>, 2005. Gifted by a prodigious memory, he helped me to reconstruct the early facts leading to the birth of Control Science as an independent discipline in Italy and abroad. I had an intense exchange of phone conversations and electronic correspondence with him in the period spanning from February to July 2002 (in my files, I have counted more than 20 e-mails exchanged with him on the historical events of control). In that period, my interest was motivated by the preparation of the booklet *Italy in IFAC, from dawn to 2003* [4]. The facts I reported in Section 3 of this paper are largely based on the information I received in this personal correspondence. A second event I would like to mention happened some day in January 2002, when I received a perfectly wrapped parcel. Inside was the complete series of the first *Information Bulletins* of IFAC, from no. 1, dated May 1958, to no. 21, dated September 1965, all in very good condition. The sender who gave me such an unexpected gift was Toni. By the way, the cover of the first among these booklets has been reproduced in Fig. 17 above. Now I keep the bulletins in my library at home as a sort of holy relic, or a premonitory token for the subsequent successful Italian bid for the IFAC World Congress of 2011.

I would also like to thank the daughters of Giorgio Quazza, Giuliana and Silvia, for the material on their father they kindly passed on to me; Fabio Saccomanno, former Professor at the University of Genoa, who was so kind as to send me some photographs and general information about the old days. The bench photo (Fig. 15) is one of them. Moreover, during the summer of 2005, I had a number of long phone conversations with Sergio Barabaschi, in connection with the preparation of my presentation of his book of 1965 in [5]. These phone contacts were very enlightening on various facts of 50 years ago I was not aware of.

Many colleagues have generously contributed to the presentation of institutes of Section 4. I am indebted to Lucio Bianco (for the IASI) , Emanuele Biondi (CTS), Maurizio Dècina (FUB), Marika Di Benedetto (PARADES), Arcangelo Distante (ISSIA), Lorenzo Finesso (LADSEB), Francesco Jovane (ITIA), Luigi Mariani (LADSEB), Benedetto Piccoli (IAC), Roberto Tempo (IEIT), Settimo Termini (ICIB) , Ezio Volta (IAN). Giorgio Picci was so kind as to help me for the short outline of Toni Lepschy life in Section 3.3. I benefited of the prodigious memory of Aldo Ascari who told me about the *incipit* of the seminar given by Giuseppe Evangelisti in 1953 for the *Seminario Matematico e Fisico* at the Politecnico di Milano.

Aldo Ascari, Marcello Farina, Giovanni Fattore, Simone Garatti, Raymund O' Brien, Mattia Testi and Erik Weyer were so kind as to read and comment preliminary versions



of this manuscript and provided useful editing and suggestions. Any inaccuracies are of course my responsibility. Gianni Marchesini, Luigi Mariani and Angelo Marzollo provided useful informations on the participants in the Bressanone meeting of 1963. Elio Bava was so kind as to pass me the book “La ricostruzione domestica” by Pier Paolo Peduccio, published by CELID (Torino) in 2005, where many useful information on the life and personality of Gustavo Colonnetti can be found.

The studies of the logo, banners and postcards of the IFAC World Congress 2011 are due to the my interactions with Martino Gereveni, graphic designer. I am indebted to him for the enthusiasm and patience extending over several months. The comments by my colleague architect Gianni Ottolini were also most valuable. The final layout of this book is due to Davide Peron and Matteo Roncaglioni.

This second “*Convegno Internazionale sui Problemi dell'Automatismo*” was organized with the support of the National Research Project *New Techniques of Identification and Adaptive Control of Industrial Systems* funded by the *Italian Ministry of University and Research* (MIUR). The Proceedings have been produced with the support of the ICT Department of the National Research Council of Italy.

The Politecnico di Milano, through the *Ufficio Comunicazione*, took care of all organizational aspects in an excellent way. Special thanks to the chief organizers Luisa Lualdi and Chiara Pesenti.

The web site of the conference <http://www.elet.polimi.it/CIRA/convnaz/2ndCIPA/> was created and maintained by Sergio M. Savaresi.

All photographs of the meeting have been taken by Gian Maria Poeta Paccati, who generously devoted his time and experience to the immortalization of the event.

## Photographs



*The speakers table (from left Bittanti, Barabaschi, Goodwin, Ballio, Kimura, Marro)*



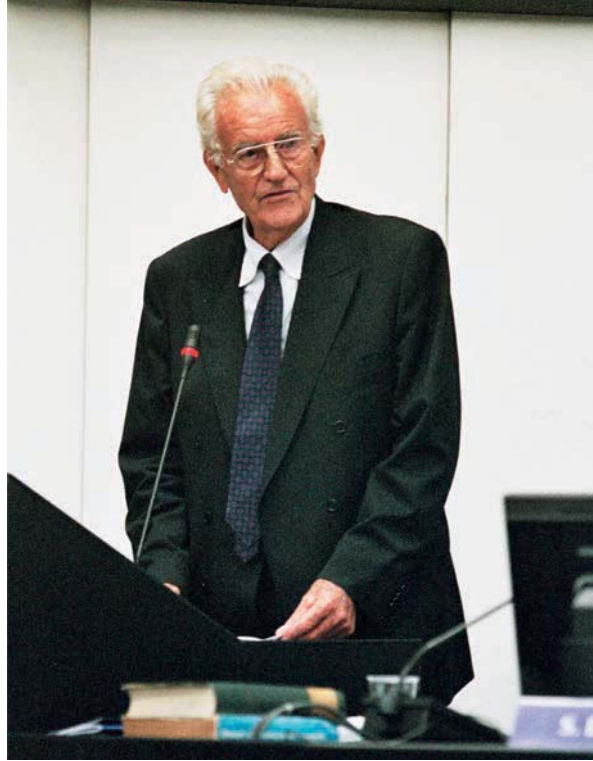
*G. Marro (right) and H. Kimura (left) in conversation*



*The President of the ICT Department of the CNR, F. Beltrame, giving his address*



*E. Gatti giving his address in the name of the Istituto Lombardo Accademia di Scienze e Lettere*



*S. Barabaschi presenting his historical lecture*



*The conference room full of attendees*



*G.C. Goodwin giving his lecture*



*H. Kimura at the opening of his lecture*



*A group of participants in the Convegno in front of the main entrance of the Politecnico di Milano*



*A group of participants in the Convegno*

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## Appendix 1

### Gustavo Colonnetti's opening speech of the Convegno of 1956

At the *Convegno Internazionale sui Problemi dell'Automatismo* of 1956, the opening address was given by Gustavo Colonnetti, President of the *National Research Council* (CNR). We reproduce here his speech drawn from the Proceedings of the *Convegno*. The republication has been kindly permitted by the CNR, under whose aegis the *Convegno* was organized and the corresponding Proceedings were published in 1958.

#### L'automazione nei suoi aspetti fondamentali

GUSTAVO COLONNETTI (\*)

##### RIASSUNTO

*Muovendo da un esame delle varie accezioni del termine «automazione» e dopo averne accolta una significazione assai comprensiva, l'A. esamina i vari problemi posti dall'automazione, così dal punto di vista tecnico-scientifico, come da quello applicativo e da quello finanziario e sociale.*

*Dal primo punto di vista, viene rilevato che i moderni sistemi automatici debbono rispondere a due fondamentali esigenze: 1) massima sicurezza e assoluta continuità di funzionamento; 2) costi i più ridotti possibili, nei riguardi sia della installazione, sia della manutenzione e dell'esercizio. Vengono, quindi, esaminate le condizioni atte a garantire la soddisfazione di tali esigenze.*

*Per quanto concerne gli aspetti applicativi, viene posto in evidenza come il problema più importante da affrontare sotto questo punto di vista, sia quello della determinazione dei limiti di convenienza economica dei procedimenti automatici rispetto a quelli manuali.*

*Viene, infine, adeguatamente affrontato il problema dal punto di vista sociale: si rileva la sostanziale positività dell'automazione dal punto di vista sociale, purché si intervenga opportunamente per modificare, all'uopo, talune strutture sociali, specie nel campo dell'istruzione universitaria e professionale.*

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(\*) Dal 14 dicembre 1956: Presidente emerito del Consiglio Nazionale delle Ricerche  
(From December 14th 1956: President Emeritus of Consiglio Nazionale delle Ricerche)



*L'A. conclude, rilevando la necessità dell'istituzione di un «Centro nazionale di automazione» capace di affrontare e risolvere i numerosi problemi tecnico-scientifici, applicativi e di carattere economico-finanziario e sociale.*

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La 6. Sessione delle «Giornate della Scienza» impegna il Consiglio Nazionale delle Ricerche su di un tema di viva e palpitante attualità, l'*automazione*, argomento che ha creato in questi ultimi tempi problemi tecnico-scientifici ed applicativi di notevole complessità e di eccezionale interesse, e che ha determinato, per i suoi riflessi di carattere economico-finanziario e sociale, vasta risonanza in tutte le nazioni più progredite del mondo.

Alla parola «automatizzazione» o «automazione» noi diamo un significato ancor più ampio di quello che gli autori anglosassoni danno di solito alla parola «automation». Ritengono, infatti, taluni che tale parola dovrebbe essere riservata a caratterizzare esclusivamente quei procedimenti automatici che fanno uso di «controreazione», nei quali cioè i risultati delle operazioni che vengono effettuate in base al programma di ordini man mano trasmessi, vengono assoggettate ad un continuo confronto con gli ordini stessi, così da poter individuare gli scarti od errori che si manifestano durante il funzionamento del sistema automatizzato, e correggerli istante per istante in modo da consentire la maggiore precisione nella sua risposta globale.

Noi riteniamo che una tale interpretazione sia eccessivamente limitativa, in quanto escluderebbe molti dei più importanti e moderni sistemi di automatizzazione.

Alcuni dei processi automatici impiegati nel settore della produzione industriale o in quello dei servizi pubblici e privati non utilizzano infatti la controreazione, e tuttavia presentano un notevole interesse pratico.

Noi attribuiremo pertanto alla parola «automation» ed a quelle che le corrispondono nelle diverse lingue il senso più lato, riservandoci naturalmente di classificare i procedimenti relativi per successivi livelli sempre più elevati; partendo da quello più basso che potremmo chiamare di soglia e ravvisare nella meccanizzazione, procedendo per livelli sempre più alti man mano che vengono introdotte operazioni di accumulo di informazioni relative al programma da attuare (organi di registrazione e di memoria, operazioni di selezione ed istradamento delle informazioni accumulate, operazioni di controllo, etc.), fino ad arrivare ai livelli più spinti che richiedono in larga misura l'uso della controreazione.

Ciò premesso conviene avvertire subito che l'automazione impone indagini complesse e delicate sotto tre fondamentali punti di vista: tecnico-scientifico; applicativo; economico-finanziario e sociale.

Dal punto di vista tecnico-scientifico, si deve subito rilevare che l'automatizzazione richiede profonde conoscenze di meccanica, scienza delle costruzioni, elettrotecnica, elettronica, fisica, chimico-fisica e chimica industriale, e di ciò ci si può facilmente con-

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vincere se si considera che tutti i moderni sistemi automatici devono rispondere a due fondamentali esigenze:

- massima sicurezza ed assoluta continuità di funzionamento;
- costi i più ridotti possibili nei riguardi delle apparecchiature richieste, della loro installazione e manutenzione e del loro esercizio.

L'importanza che la sicurezza e la continuità di funzionamento assumono nell'uso dei procedimenti automatici, appare manifesta se si considera che un arresto nel loro funzionamento può determinare gravissimi danni economici, in quanto, nel caso di produzione industriale, viene a ridursi notevolmente il volume della produzione e, nel caso di servizi pubblici e privati, vengono a determinarsi preoccupanti riduzioni di introiti.

La necessità di bassi costi dei sistemi automatizzati emerge in tutta la sua importanza, se si tiene conto che l'automazione verrà in pratica effettuata solamente se essa apporta riduzioni nei costi della produzione o dei servizi.

Ne segue dunque che, nello studio e nella realizzazione dei vari sistemi di automazione, è assolutamente necessario procedere ad una accurata scelta degli elementi componenti che dovranno possedere caratteristiche tecniche ben definite, uniformi e costanti nel tempo, indipendentemente dalle sollecitazioni ambientali a cui possono trovarsi sottoposti; risulta necessario inoltre che, nell'individuazione del sistema, il numero degli elementi componenti sia il più ridotto possibile e che essi siano raggruppati secondo schemi di alta efficienza funzionale, in modo che si possa conseguire la più grande sicurezza e continuità di funzionamento e bassi costi globali.

L'automazione richiede quindi sempre continui affinamenti nella ricerca ed indagini scientifiche e tecniche, nonché la creazione di nuovi materiali dielettrici, magnetici e semiconduttori, di nuovi procedimenti tecnologici e infine la creazione di tutta una vasta gamma di sistemi di controllo miranti ad accrescere la precisione e la rispondenza dei sistemi automatizzati nei vari settori dell'attività umana.

Per poter meglio valutare la complessità dei numerosi problemi sollevati dall'automatizzazione dal punto di vista tecnico-scientifico, basta tenere presente che il funzionamento di un processo automatizzato è sottoposto a continue variazioni nel tempo, cosicché si rende necessaria la risposta dell'intero sistema non in periodo di regime, ma in periodo transitorio; ed è a tutti ben noto come lo studio dei fenomeni transitori sia enormemente più difficoltoso di quello dei fenomeni di regime.

Senza ulteriormente addentrarmi negli aspetti scientifico-tecnici dell'automazione, poiché essi faranno oggetto di relazioni approfondite da parte degli esperti in materia, e passando a considerare gli aspetti applicativi, sia nel settore della produzione industriale come in quello dei servizi pubblici e privati, vorrei qui dire soltanto che il problema più importante da affrontare è quello che riguarda la determinazione dei limiti di convenienza economica dei procedimenti automatici rispetto a quelli manuali.

È da rilevare a tale riguardo che per poter stabilire tali limiti di convenienza, occorre aver definito in tutti i suoi dettagli il sistema di automatizzazione da adottare, sia per accertare la sua migliore rispondenza rispetto a quello manuale e più ancora per valutare, con la massima precisione possibile, il costo delle apparecchiature necessarie, della loro installazione, della loro manutenzione e del loro esercizio, nonché la loro presumibile durata, e stabilire così un confronto tra i costi nel caso di soluzione automatica e nel caso di soluzione manuale.

Tali costi, se si tratta di produzione industriale, vanno riferiti ai quantitativi di produzione, in modo da determinare il quantitativo per il quale si verifica eguaglianza per la soluzione automatica e per quella manuale, colla ovvia conclusione che per quantitativi di produzione maggiori di quello così determinato, l'automazione risulta sempre più conveniente, man mano che cresce il volume della produzione stessa.

Nel caso dei servizi pubblici e privati, i costi vanno riferiti al numero degli utenti, ed anche in tal caso si tratta di determinare il numero in corrispondenza del quale si ha eguaglianza di costo tra servizi automatizzati e manuali; è ovvio che anche qui l'automazione finisce per imporsi in misura sempre più manifesta, man mano che s'incrementa lo sviluppo dei servizi a cui essa è applicata.

Passando ora a considerare i riflessi sociali dell'automazione, si può rilevare che essi si manifestano in misura molto diversa da nazione a nazione e sono strettamente dipendenti dalla densità di popolazione e dal livello sociale raggiunto.

Per quanto non sia facile fare previsioni in merito, riteniamo tuttavia di poter affermare che tutte le volte che l'automazione viene adottata in base a risultati di indagini che assicurino con margini adeguati, e possibilmente molto larghi, la sua convenienza economica, e nello stesso tempo miglioramenti validi ed effettivi nella qualità della produzione o nella rispondenza dei servizi, essa finisce per non determinare preoccupazioni dal punto di vista dell'utilizzazione della mano d'opera, poiché se questa viene a subire notevole diminuzione nelle organizzazioni in cui l'automazione è stata applicata, adeguati compensi vengono quasi sempre a determinarsi in altre organizzazioni strettamente dipendenti o legate ad essa.

In generale si può affermare che l'automazione, se applicata con criteri logici e razionali, non determina una diminuzione del contributo dell'uomo nelle diverse attività sociali, ma solamente una differente redistribuzione di tale contributo che finisce quasi sempre per aumentare di importanza, portandosi a livelli più alti e determinando una netta elevazione di carattere sociale.

In realtà l'automazione impone una sempre maggiore specializzazione dei tecnici che vi attendono; di qui la necessità di profonde riforme, sia nell'istruzione universitaria, sia nell'istruzione professionale che va potenziata ed estesa in misura adeguata.

Essa rende inoltre necessari corsi di riqualificazione ed addestramento nei più bassi livelli di mano d'opera e pone pertanto problemi che vanno urgentemente affrontati se si vuole veramente fronteggiare con risultati positivi gli inevitabili sviluppi che l'automazione va sempre più assumendo.

Dalle brevi considerazioni esposte io vorrei trarre la conclusione della necessità di istituire un *Centro nazionale di automazione*, capace di affrontare e risolvere i numerosi problemi tecnico-scientifici, applicativi e di carattere economico-finanziario e sociale.

Un tale Centro dovrebbe provvedere, dal punto di vista tecnico-scientifico, a classificare e coordinare i diversi sistemi di automazione; a precisare con il massimo rigore possibile le caratteristiche tecniche dei componenti che entrano in una catena di automazione, nonché la rispondenza nel funzionamento della catena stessa e le tolleranze ammissibili; ed infine ad avviare ricerche intese a risolvere tutti i nuovi problemi di automazione che man mano insorgono, ed a migliorare l'efficienza dei sistemi già realizzati.

Dal punto di vista applicativo nel settore industriale ed in quello dei servizi pubblici e privati dovrebbe provvedere a raccogliere e coordinare i risultati conseguiti dall'automazione nelle applicazioni già attuate nei diversi settori di produzione industriale (meccanica, chimica, cartaria tessile, elettrica, etc.) e in quelli dei servizi pubblici e privati (servizi telegrafonici, postali, ferroviari, navali, aeronautici, di credito, di vendita, etc.) non solamente in Italia, ma in tutte le nazioni più progredite per poter disporre di elementi validi nella determinazione dei limiti di convenienza dei procedimenti automatici rispetto a quelli manuali.

Dal punto di vista sociale dovrebbe provvedere ad individuare in base ai risultati conseguiti nelle applicazioni dei procedimenti automatici nei diversi settori di attività, i provvedimenti per la qualifica e l'addestramento della mano d'opera nonché quelli relativi alle riforme da riguardi dell'istruzione universitaria e nei riguardi dei corsi industriali.

Se la proposta di istituzione di un tal Centro troverà la vostra autorevole approvazione, il Consiglio Nazionale delle Ricerche la presenterà senz'altro al Governo, certo che questo non mancherà di valutare adeguatamente l'enorme importanza che l'automazione sta per assumere nel mondo della produzione, e la necessità di fronteggiare tempestivamente i profondi sconvolgimenti che essa potrebbe determinare in tutto il nostro assetto economico e sociale.

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## RÉSUMÉ

L'automation et ses aspects fondamentaux.

*L'auteur nous présente d'abord un examen des différentes acceptions du mot « automation » et nous en donne une interprétation très précise et compréhensible. Ensuite l'auteur passe à examiner les divers problèmes qui gissent comme conséquence de l'automation soit au point de vue technique et scientifique, soit au point de vue de l'application, soit enfin au point de vue financier et social.*

*Quant au point de vue technique et scientifique, l'auteur tient à souligner que les systèmes automatiques modernes doivent répondre aux deux exigences fondamentales sui-*

vantes: 1) sûreté maximum et continuité absolue du fonctionnement; 2) coûts les plus bas possibles soit par rapport à l'installation, soit par rapport à la manutention et à l'exercice.

Après cela l'auteur examine les conditions qui peuvent assurer l'accomplissement des exigences ci-dessus.

Quant à la question de l'application, l'auteur met en évidence que le problème le plus important à résoudre en ce domaine est celui de déterminer les limites de la convenance économique des procédés automatiques par rapport aux procédés manuels.

L'auteur passe enfin à examiner le problème au point de vue social. Il met en évidence les aspects fondamentalement positifs de l'automation au point de vue social à condition que l'on intervienne d'une façon convenable pour transformer certaines structures sociales. Cela se rapporte surtout au domaine de l'enseignement dans les universités et de l'instruction professionnelle.

Pour conclure l'auteur souligne la nécessité d'instituer un « Centre national de l'automation » qui ait la capacité d'examiner et de résoudre les nombreux problèmes techniques, scientifiques, applicatifs et de nature économique, financière et sociale relevant de l'automation.

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## SUMMARY

Automation and its basic aspects.

The author begins with an analysis of the different meanings of the term « automation » and formulates a very precise and comprehensible definition of such a term. He then discusses various problems connected with automation from a scientific, technical, applicational, financial and social point of view.

From the scientific and technical points of view it is stressed that the modern automatic systems should satisfy the following two basic requirements: 1) overall security and absolute continuity of operation: 2) costs reduced to a minimum with respect to installation maintenance and operation.

The author also examines the conditions capable to guarantee the accomplishment of such requirements.

As for the application of automation, particular emphasis is put on the fact that the most important problem to be solved in this field is the determination of the limits of economical convenience of automatic proceedings in comparison with manual proceedings.

Finally the author examines the problem also from the social point of view. He stresses upon the fact that from the social point of view automation is substantially a posi-

*tive event provided that appropriate modifications are made in certain social fields, especially in the field of university and professional training.*

*The author concludes this paper pointing out the necessity of establishing a «National Automation Centre» with the purpose of examining and solving technical, scientific, applicational, economical, financial and social problems connected with automation.*

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## ZUSAMMENFASSUNG

Die Automation und ihre grundlegenden Gesichtspunkte.

*Verf. geht von einer Untersuchung der verschiedenen Bedeutungen des Begriffs «Automation» aus und bringt eine recht genaue und verständliche Definition dieses Begriffs. Er untersucht auch die verschiedenen von der Automation hervorgerufenen verschieden Probleme technisch-wissenschaftlicher, finanzieller und sozialer Art. Er betrachtet das Problem auch vom Standpunkt der Anwendung der Automation.*

*Vom technisch-wissenschaftlichen Standpunkt aus wird hervorgehoben, dass die modernen automatischen Systeme den folgenden zwei Grundforderungen entsprechen müssen: 1) Maximale Sicherheit und absolute Kontinuität des Betriebs; 2) Kleinstmögliche Kosten in Bezug auf Installation, Instandhaltung und Betrieb.*

*Anschließend werden auch die Bedingungen besprochen, die zur Befriedigung der oben genannten Erfordernisse als angebracht erscheinen. Bezüglich des Einsatzes der Automation wird hervorgehoben, dass das wichtigste auf diesem Gebiet zu lösende Problem die Feststellung der Grenzen wirtschaftlicher Rentabilität der automatischen Verfahren im Vergleich zu Handverfahren sei.*

*Weiterhin wird das Problem auch vom sozialen Gesichtspunkt ausgiebig untersucht. Verf. hebt hervor, dass bei einer entsprechenden Umänderung gewisser sozialer Strukturen besonders auf dem Gebiet der Hochschul- und Berufsausbildung die Automation eine ausgesprochen positive Erscheinung sei.*

*Zum Abschluss weist Verf. auf die Notwendigkeit der Einrichtung einer «Nationalen Studienstelle für Automation» hin, die in der Lage sei, die zahlreichen durch die Automation entstehenden Probleme technisch-wissenschaftlicher, wirtschaftlich-finanzieller und sozialer Art zu untersuchen und zu lösen.*

## Appendix 2

### Petar Kokotovic's speech on the occasion of the 25-th anniversary of Giorgio Quazza death

On the late afternoon of June 26, 2003, during the 4th IFAC Symposium on "Robust Control Design" (Milano June 25 - 27, 2003), a meeting was held to commemorate the 25-th anniversary of the death of Giorgio Quazza and to celebrate his legacy to the control community. Among others, Petar Kokotovic, Professor, University of California at Santa Barbara, a close friend of Giorgio, gave a touching speech.

I thought to render a service to our community to replicate that speech herein, especially for the benefit of all those who did not have the privilege of meeting Giorgio. Petar was so kind to accept to transform his recorded speech into a written document (with some minor editing).

#### Remembering Giorgio Guazza (1924-1978)

##### *PETAR KOKOTOVIC*

I had the good fortune to get to know Giorgio closely as one of the leaders at ENEL and IFAC, and above all, as a true humanist and friend.

It happens that sometimes an international organization brings you in contact with a person you will remember for the rest of your life and who will influence you both professionally and personally. This happened to me when I was the chair of the IFAC Theory Committee in the early seventies, and Giorgio was the chair of the Applications Committee. We were supposed to be in some kind of competition, because these two committees always competed for the number of papers to be accepted for the IFAC World Congress. But, the moment we met, he said: "What are you doing after the committee meeting is over? Let's go for a walk." From then on, Giorgio and I would frequently escape from a session, or make a committee meeting shorter, to go for a walk.

We started our walks in Finland. A few years later we hiked in the Dolomites, as shown in this photo. There were times when we would reserve the same hotel room to be able to talk long nights. In these talks Giorgio revealed his astounding, multidimensional personality, like those I encountered in great novels by Tolstoy, Balzac, Stendhal. Pursuing some lucid thought, he was often unaware whether he was expressing it in English or French. Listening to him you wanted to dig deeper to get to all the riches of his intellect.

Giorgio was a humanist in the broadest meaning of that term. Our discussions ranged from religion to philosophy, literature, science and engineering. He was broadly educated and well read, but he would show this only if you insisted to know more about him. On a couple of occasions I asked him about his war experience, when as a very young man he joined the resistance. They were caught, five of them, and locked in a freight train heading north to the Mauthausen concentration camp. On the third night of the slow train ride, exhausted and starving, they somehow cracked an opening and jumped out of the train. Tragically, they jumped directly in front of Nazi soldiers who opened fire and killed several of Giorgio's comrades. Giorgio survived and was taken to the concentration camp, where the conditions were unbearable, as you can imagine. Giorgio's situation was even worse, because he had to sleep in between two prisoners from Yugoslavia, who tried to kill each other across Giorgio's body. After several days, Giorgio was able to calm them down. Yes, Giorgio was ready to take great personal risks to help others and was a deep inspiration for all of us.

As a technical leader, Giorgio inspired his coworkers. He suggested in one of our discussions that large scale systems should be the next major direction in control theory. He worked tirelessly to connect power system researchers with control researchers. He brought me in contact with the ENEL Center and our dear friend Fabio Saccomanno who is here to tell us more about his work with Giorgio. I was so influenced by some of the work at ENEL that we wrote a proposal to the US Department of Energy, which successfully evolved into our slow coherency methodology, still in use today.

Giorgio did not live to see the completion of that work, but he saw intermediate results at our meetings.





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Giorgio seemed to be everywhere and yet hard to notice. You would be in a committee meeting and he would be quiet, but when he said a few words you knew these words came from an authority, with full knowledge of the facts. I felt that every moment spent with Giorgio enriched me.

I was very enthusiastic to receive the invitation to come here and say a few words about this gifted, modest, inspiring humanist and engineer. We lost him 25 years ago, a person who survived a concentration camp to lead and inspire many researchers and engineers. We lost him in his beloved mountains to which he would invite me, although I was not strong enough to follow him on all of his climbs. On our early summer hike in this photo he said: "No, I'm not ready for a big hike yet, I can not make six hundred vertical meters in one hour." Tragically, when in the late summer he was ready for glacier skiing, a crevasse opened and took him from us.

At memorials we always say "there was a perfect man", but for me, Giorgio was indeed close to that ideal. It is with great pleasure and immense sadness that I invite you to remember Giorgio and continue his legacy.

*Recorded at the Quazza Memorial, June 2003, Milano, transcribed and edited May, 2007*

## 17<sup>th</sup> IFAC World Congress

*Closing ceremony of July 11, 2008, in the Auditorium of the COEX Congress Centre in Seoul.*



*Presentation of the 18<sup>th</sup> IFAC World Congress to be held in Milan (photograph by SungKwang Myoung)*



*During the closing ceremony, the passage of the gavel and the seal from W. H. Kwon to A. Isidori witnesses the turn in IFAC Presidency (photograph by SungKwang Myoung)*



*Seoul, December 7, 2007: during his travel to Korea S. Bittanti inspects the banner cabinet with the assistance of W. H. Kwon, IFAC President*



*Milan, June 9, 2007: the banner for the 18th IFAC World Congress is ready (photo by G. Nizzola)*