



POLITECNICO
MILANO 1863



Automatica 4.0

Elogio dell'automatica

Sergio Bittanti



- **THE BIG BANG**
- **FORERUNNERS EVENTS**
- **ROLE OF CNR**
- **FIFTY YEARS LATER**
- **INTERNATIONAL IMPACT**
- **POLIMI EXPERIENCE**
- **STAR EPILOGUE**



11 September



11 September 1957

the foundation of IFAC





Forerunner event Heidelberg September 1956 TAGUNG REGELUNGSTECHNIK



J.H. WESTCOTT
1920 - 2014



Forerunner event Heidelberg September 1956 RESOLUTION

RESOLUTION

Die Unterzeichneten befürworten die Gründung eines internationalen Verbandes für Regelungstechnik und erklären sich bereit, sich für diese Gründung in ihrem Heimatland einzusetzen. Der Verband soll zum Ziel haben:

1. den Austausch von Informationen auf dem Gebiete der Regelungstechnik zu erleichtern und dieses Gebiet zu fördern.
2. Internationale Kongresse für Regelungstechnik in die Wege zu leiten.

Heidelberg, 27. Sept. 1956

gez. Otto Grebe, Deutschland	gez. Werner Fohlens, Deutschld.
gez. Rufus Oldenburger, United States	gez. G. Evangelisti, Italien
gez. A. Tustin, Great Britain	gez. J. Boas-Popper, Israel
gez. J.F. Coales, Great Britain	gez. M. Ajnbinder, Belgique
gez. J.H. Westcott, Great Britain	gez. Ph. Passau, "
gez. H. Märzendorfer, Österreich	gez. Victor Broïda, France
gez. M. Mesarović, Jugoslavien	gez. Paul Profos, Schweiz
gez. J.M.L. Janssen, Netherlands	gez. L. v. Hamos, Schweden
gez. Jens G. Balchen, Norwegen	gez. Strejco Vladimir, CSR
gez. Jens R. Jensen, Danmark	gez. Hanuš, Bofivoj, CSR
gez. Gerd Müller, Deutschland	gez. A.M. Letow, UdSSR
gez. P.J. Nowacki, Polska-Polen	gez. Keisuke Isawa, Japan
gez. Heinrich Kindler, Deutschland	gez. G. Ruppel, Deutschland
gez. H. Chestnut, USA	

Briefe an das Vorläufige Sekretariat

sind zu richten an:
Letters to the Provisional
Secretary should be mailed to:

VDI/VDE-Fachgruppe
Regelungstechnik
Prinz-Georgstr. 79

D ü s s e l d o r f

Kopie erbeten an:
Copy should be sent to:

Prof. Dr. Rufus Oldenburger
Purdue University
Lafayette, Indiana, USA



Forerunner event Heidelberg September 1956 RESOLUTION



G. Evangelisti

RESOLUTION

Die Unterzeichneten befürworten die Gründung eines internationalen Verbandes für Regelungstechnik und erklären sich bereit, sich für diese Gründung in ihrem Heimatland einzusetzen. Der Verband soll zum Ziel haben:

1. den Austausch von Informationen auf dem Gebiete der Regelungstechnik zu erleichtern und dieses Gebiet zu fördern.
2. Internationale Kongresse für Regelungstechnik in die Wege zu leiten.

Heidelberg, 27. Sept. 1956

gez. Otto Grebe, Deutschland	gez. Werner Fohlens, Deutschld.
gez. Rufus Oldenburger, United States	gez. G. Evangelisti, Italien
gez. A. Tustin, Great Britain	gez. J. Boas-Popper, Israel
gez. J.F. Coales, Great Britain	gez. M. Ajnbinder, Belgique
gez. J.H. Westcott, Great Britain	gez. Ph. Passau, "
gez. H. Märzendorfer, Österreich	gez. Victor Broïda, France
gez. M. Mesarović, Jugoslavien	gez. Paul Profos, Schweiz
gez. J.M.L. Janssen, Netherlands	gez. L. v. Hamos, Schweden
gez. Jens G. Balchen, Norwegen	gez. Strejco Vladimir, CSR
gez. Jens R. Jensen, Danmark	gez. Hanuš, Bofivoj, CSR
gez. Gerd Müller, Deutschland	gez. A.M. Letow, UdSSR
gez. P.J. Nowacki, Polska-Polen	gez. Keisuke Isawa, Japan
gez. Heinrich Kindler, Deutschland	gez. G. Ruppel, Deutschland
gez. H. Chestnut, USA	

Briefe an das Vorläufige Sekretariat

sind zu richten an:
Letters to the Provisional
Secretary should be mailed to:

Kopie erbeten an:
Copy should be sent to:

VDI/VDE-Fachgruppe
Regelungstechnik
Prinz-Georgstr. 79

D ü s s e l d o r f

Prof. Dr. Rufus Oldenburger
Purdue University
Lafayette, Indiana, USA



Forerunner event Milano April 1956 CONVEGNO INT SUI PROBLEMI DELL'AUTOMATISMO



President of CNR
G. Colonnetti



President of Italian Republic
G. Gronchi



THE BIG BANG

Proceedings of Convegno Internazionale sui Problemi
dell'Automatismo, CNR, 1958



1956, Milano

PROCEEDINGS CONVEGNO INTERNAZIONALE SUI PROBLEMI DELL'AUTOMATISMO

Convegno
General Secretaries



A. Lepschy
(1931 – 2005)



A. Ruberti
(1927 – 2000)



A. Ruberti Lectio Magistralis - Roma 1999





THE LEPSCHY GIFT





Proceedings of Convegno Internazionale sui Problemi
dell'Automatismo, CNR, 1958

Collana di automatica del CNR VOL 0



Collana di automatica del CNR

VOL 1, 1965 **PROBLEMI ATTUALI DI CONTROLLI AUTOMATICI**



SEMINARIO
DI CONTROLLI
AUTOMATICI

BRESSANONE 1963



Collana di automatica del CNR

VOL 1, 1965 **PROBLEMI ATTUALI DI CONTROLLI AUTOMATICI**



A. Lepschy and A. Ruberti
**Metodi di identificazione
di sistemi lineari e normali (38 pg)**



Collana di automatica del CNR

VOL 0, 1958 **ATTI CONV INT SUI PROBLEMI DELL'AUTOMATISMO**
(Milano 1956)

VOL 1, 1965 **PROBLEMI ATTUALI DI CONTROLLI AUTOMATICI**
(Bressanone 1963)

VOL 2, 1967 **IDENTIFICAZIONE E OTTIMIZZAZIONE**
(Bressanone 1964, 1965)

VOL 3, 1970 **STOCHASTIC PROCESSES IN AUTOMATIC CONTROL**
(Cagliari 1966)

VOL 4, 1978 **IDENTIFICAZIONE DEI SISTEMI STOCASTICI**
(Palermo 1977)

VOL 5, 2008 **CONTROL SCIENCE EVOLUTION**
(Milano 2006)



CNR ITALIAN NMO



INTERNATIONAL FEDERATION
OF AUTOMATIC CONTROL



Representatives of the NMO

Guido Guardabassi for many years

Edoardo Mosca (1996 – 2014)

Roberto Tempo (2015 – 2016)

Patrizio Colaneri (2017 –)

IFAC Presidency

Alberto Isidori (2008-2011)

Council Members

Giuseppe Evangelisti (1957 – 1961)

Giorgio Quazza (1975 – 1978)

Umberto Pellegrini (1981 – 1984)

Guido Guardabassi (1984 – 1990)

Alberto Isidori (1993 – 1996)

Edoardo Mosca (1996 – 2002)

Sergio Bittanti (2002 – 2005)

Sergio Bittanti (2014 – 2017)

IFAC

... and many others scholars serving in this or that IFAC Committee!



... fifty years later



FIFTY YEARS LATER

... again in Heidelberg September 2006





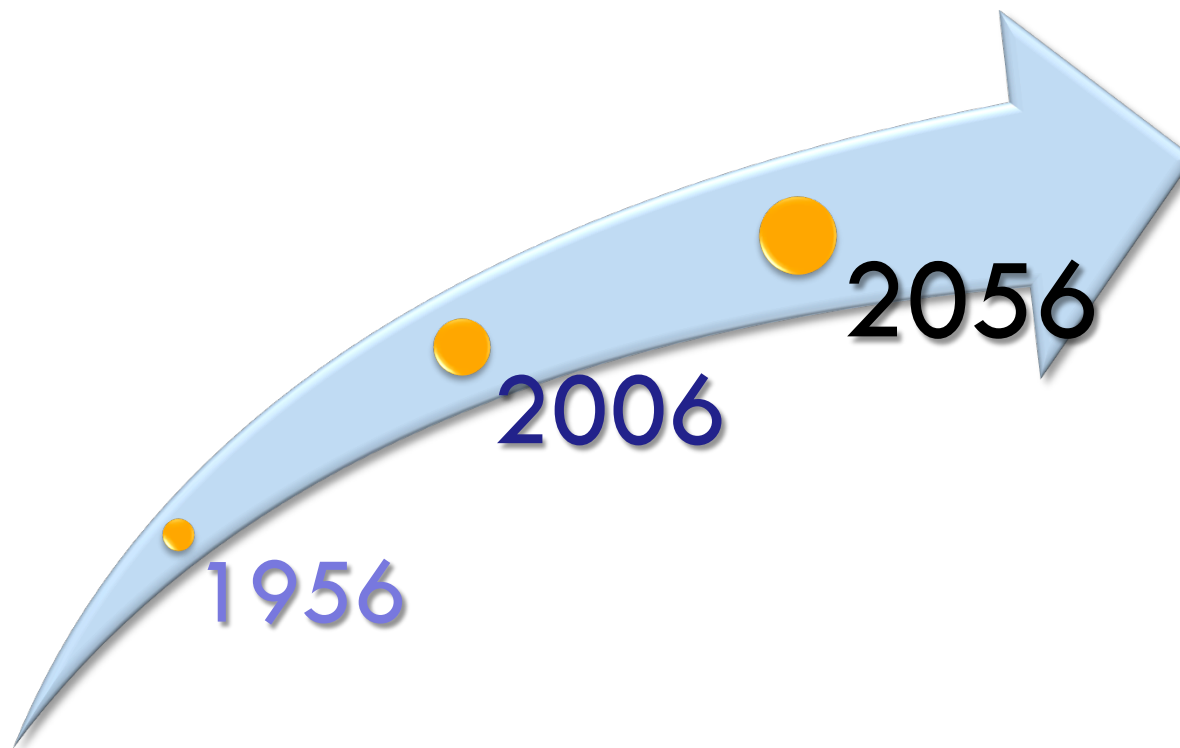
FIFTY YEARS LATER

... again in Milano September 2006
Second Convegno Int. sui Problemi dell'Automatismo





2056
Third
CONVEGNO INTERNAZIONALE SUI PROBLEMI
DELL'AUTOMATISMO





INTERNATIONAL ASSOCIATIONS

IFAC

IEEE CSS and RAS

EUCA



IFAC WORLD CONGRESS MILANO 2011



A TEAM



THE OPENING

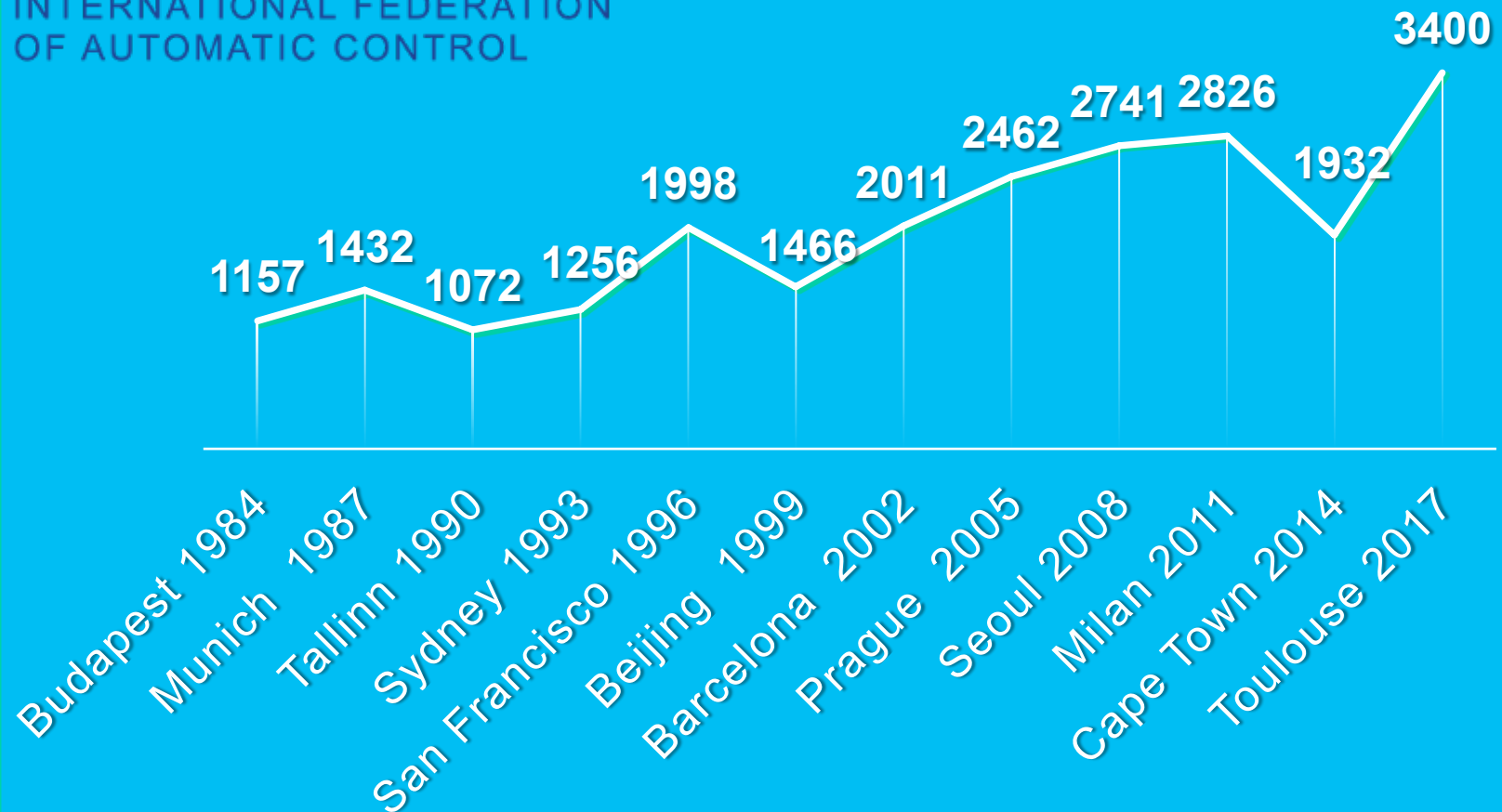
IT INNOVATIONS
booklet Italy in IFAC
friendship evening
Manifesto





IFAC WORLD CONGRESS ATTENDANCE

INTERNATIONAL FEDERATION
OF AUTOMATIC CONTROL





IEEE CSS Presidency

Roberto Tempo (2010)

Elena Valcher (2015)

Francesco Bullo (2018)

IEEE
CSS



CDC IN FLORENCE 2013



IEEE RAS Presidency

Paolo Dario (2002-03)

Bruno Siciliano (2008-09)

IEEE
RAS



2007 IEEE International Conference on
Robotics and Automation (ICRA), Roma



EUCA

ECC in Italy

Rome 1995

Naples 2019

ECC Presidents (2011)

ECC 1999 held in Karlsruhe, Germany, with Paul M. Frank as President - Paul passed away in 2005.



Kalman filtering

Nonlinear systems and control

Predictive control

Optimization

Data driven control design

Stochastic methods

Learning

Robust control and filtering

Recursive identification

Data analysis

Optimal control

Adaptive systems

Periodic control & cyclic automation



Fondazione CARIPLO *Nuovo Pignone* **Agusta** **SGS**

British Telecom

GPS Standard

Riva-Calzoni

CESI **ABB**

L.G.L. Electronics

Ferrari

ENEL

SAME Deutz-Fahr

Danieli

Pirelli

IBM

Whirlpool

Tiscali

RSE

Gaymarine ST Microelectronics *Fondazione Volta*

MEMC Electronic Materials Pirelli **Brembo**



Fondazione CARIPL0 *Nuovo Pignone* **Agusta** **SGS**
Kalman filtering Nonlinear systems and control

British Telecom *GPS Standard* **Riva-Calzoni**
Predictive control Optimization

CESI **ABB** *L.G.L. Electronics* Ferrari
Data driven control design **Stochastic methods**

ENEL SAME Deutz-Fahr **Danieli**
Learning *Pirelli* **Robust control and filtering**

IBM Recursive identification **Tiscali** **RSE**
Optimal control *Whirlpool* **Data analysis**

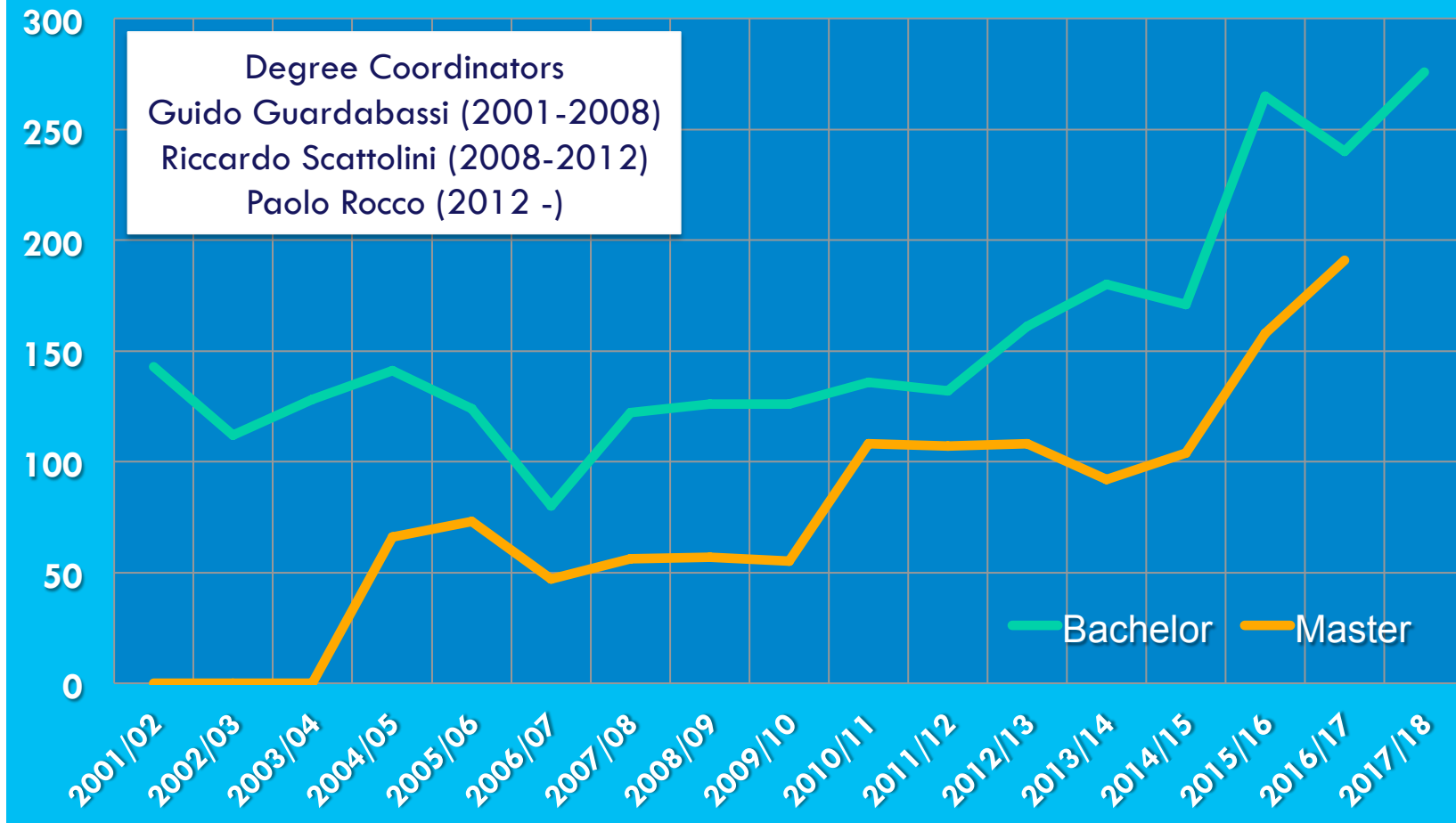
Gaymarine *ST Microelectronics* *Fondazione Volta*
Adaptive systems

Periodic control & cyclic automation

MEMC **Electronic Materials** *Pirelli* **Brembo**



COURSE OF AUTOMATION ENGINEERING B vs M





Giorgio Quazza



Collana di automatica del CNR

VOL 1, 1965 **PROBLEMI ATTUALI DI CONTROLLI AUTOMATICI**



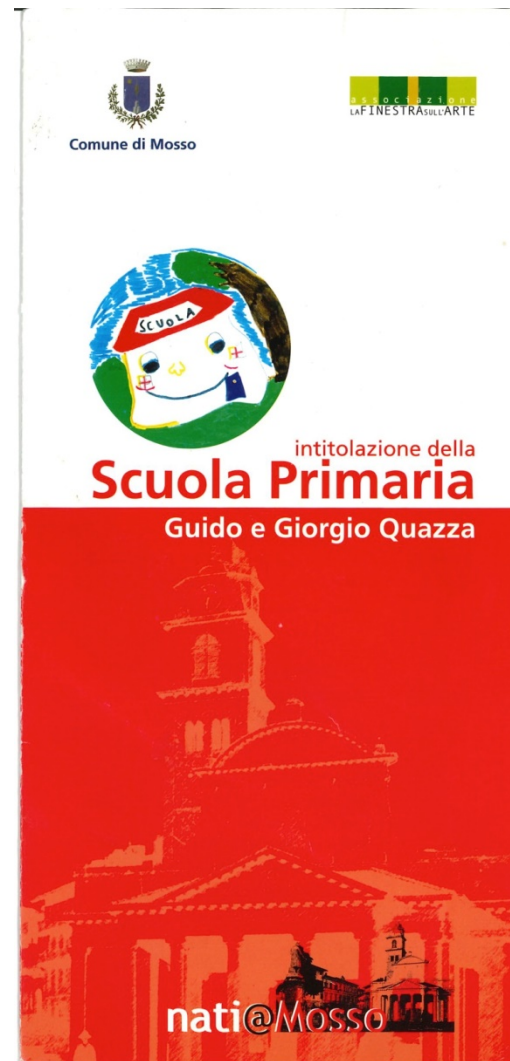
G. Quazza

Sistemi a più

variabili regolate (48 pg)



Guido & Giorgio Quazza





Giorgio Quazza Medal of IFAC





FOUR SCHOLARS ON A BENCH
A. Ruberti, E. Biondi, G. Quazza, A. Lepschy



CENTRO CNR PER LO STUDIO DELLA TEORIA DEI SISTEMI c/o Polimi

E. Biondi founder and director from 1971 to 1991





POLIMI EXPERIENCE



DATA SCIENCE EARLY DAYS



DATA SCIENCE EARLY DAYS





MODEL IDENTIFICATION AND DATA ANALYSIS

since 1977 – course at POLIMI



STUDENTS IN THE CLASSROOM



BOOKS
last edition 2017

“All models are wrong,
some are useful”
(George Box)



Automation of energy systems and process control

Automation of transport systems

Aerospace control

Control and computers

Control in bio

Mechatronics

Control of water nets

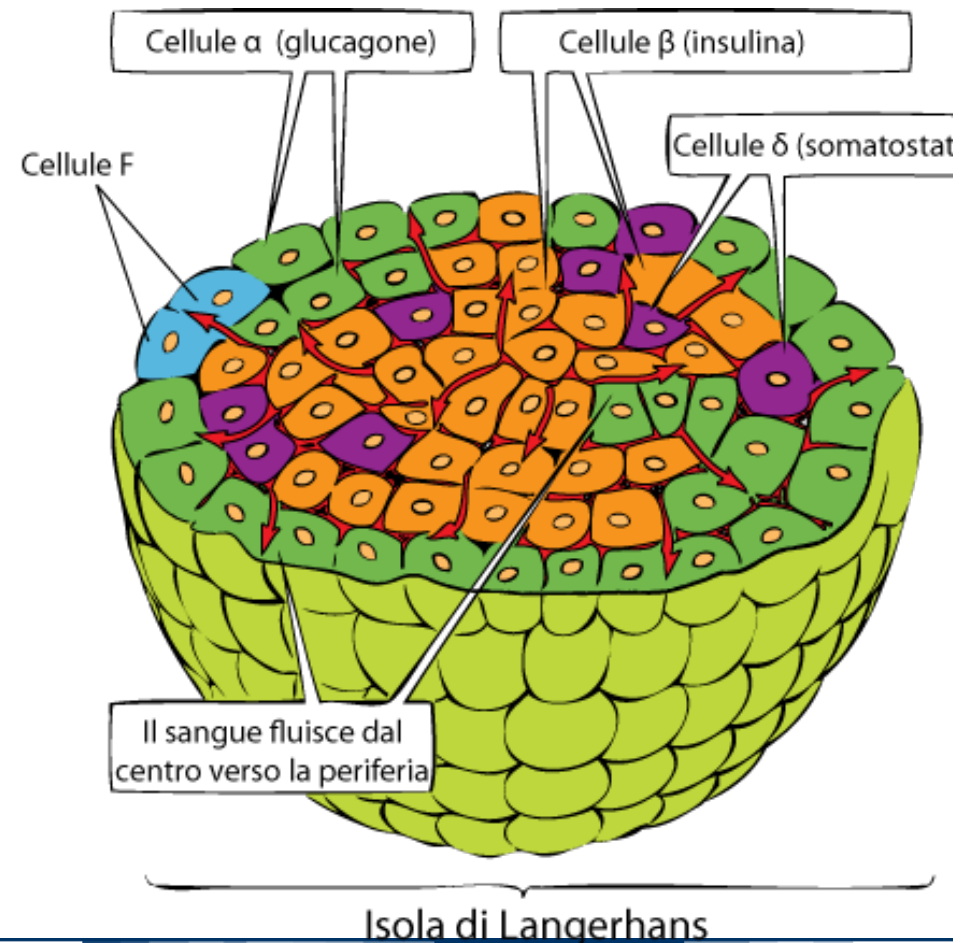


Glycaemia control in nature

Regulation with two
Hormones: insulin and
glucagon

Produced by pancreas
In the “Langerhans isles”

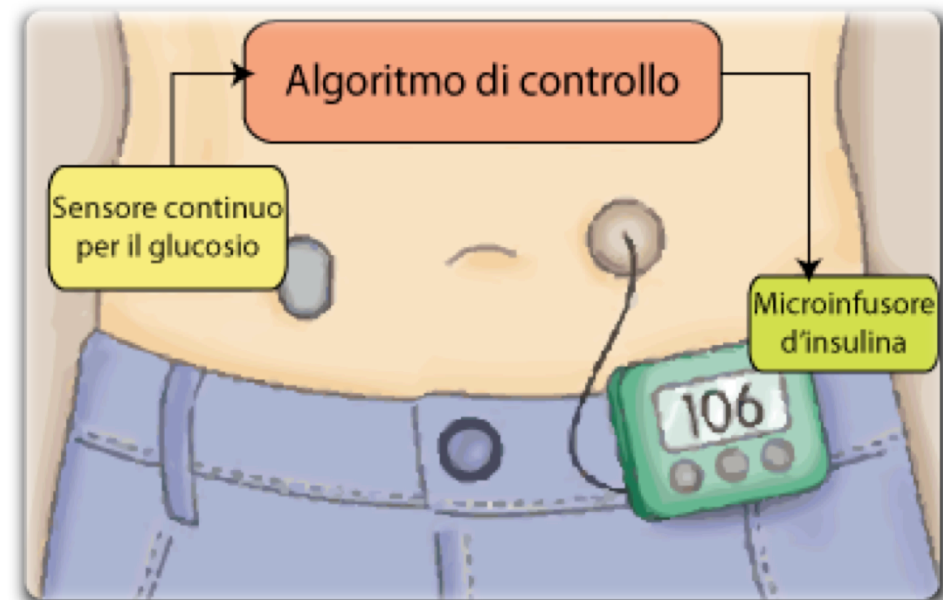
Glucagon: glucose +
Insulin: glucose -





Artificial control of glycaemia

- Subcutaneous sensor for measurement of glycemia (Patch)
- Insulin micro infusion actuator
- Control algorithm




**Artificial Pancreas =
closed loop control of glycaemia**



1984, Villa Olmo

**IDENTIFICAZIONE
CONTROLLO E OTTIMIZZAZIONE
DEI SISTEMI DINAMICI**

Incontro congiunto dei ricercatori afferenti ai Progetti Nazionali:
— Metodologie e Dispositivi per l'Identificazione, il Controllo e l'Elaborazione dei Segnali nei Sistemi Dinamici
— Teoria del Controllo e Ottimizzazione dei Sistemi Dinamici


Centro di Cultura Scientifica "A. Volta"
Villa Olmo, Como
12-15 giugno 1984

Temi dell'incontro:
Identificazione e modelli stocastici, Sistemi lineari, Sistemi non lineari, Controllo ottimo, Controllo decentralizzato, Controllo adattativo, Modellistica e simulazione

Contributi di:
G. Ambrosino, G. Anichini, A. Antoulas, A. Bacciotti, G. Bartolini, G. Belforte, G. Bertoni, R.M. Bianchini, S. Bittanti, P. Bolzern, B. Bona, C. Bonivento, G. Capitani, G. Casalino, G. Celestino, P. Colaneri, G. Conte, R. Contorno, G. Conti, R. Conti, G. Crosta, F. Davoli, M.D. Di Benedetto, L. Finesso, E. Fornasini, O.M. Grasselli, C. Greco, G. Guardabassi, A. Isidori, A. Lappaschy, A. Locatelli, S. Longhi, R. Lucchetti, C. Maffezzoni, G. Marchesini, R. Marino, M. Milanese, R. Minciardi, S. Monaco, E. Mosca, P. Nistri, D. Normand-Cyrot, L. Pandolfi, F. Parodi, M.E. Penati, A.M. Perdon, G. Picci, R. Salomone, E. Sarti, R. Scattolini, N. Schiavoni, G. Stefani, R. Tempo, F. Terragni, A. Tiano, M. Tibaldi, A. Tonelli, A. Vicino, G. Zappa, P. Zecca, T. Zolezzi

Il giorno 11 giugno 1984, con inizio alle ore 15.00, R.E. Kalman terrà nella stessa sede una serie di seminari sul tema "New Theory of System Identification from Noisy Data".

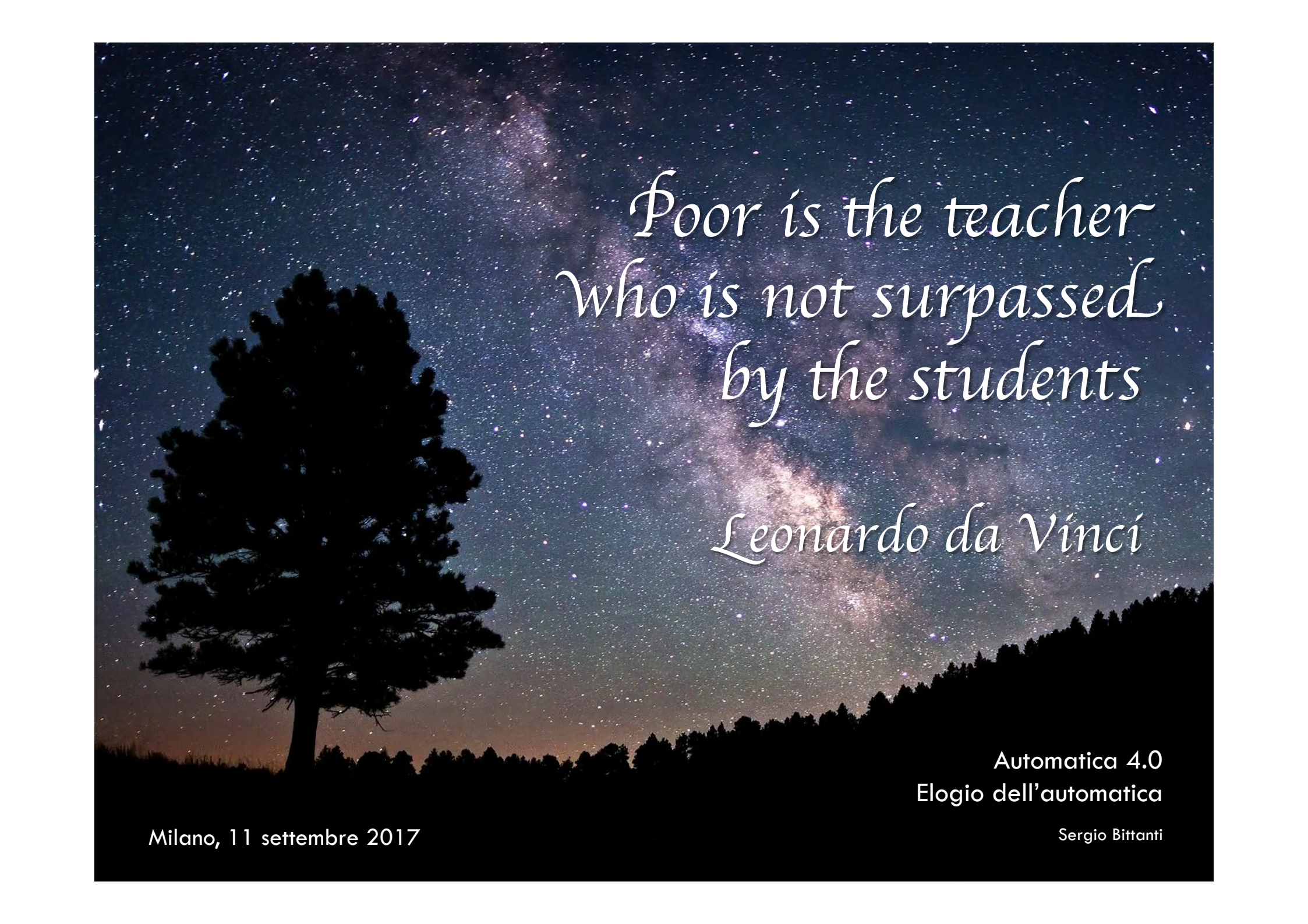
Per informazioni rivolgersi a:

S. Bittanti Dipartimento di Elettrotecnica Politecnico di Milano Piazza L. da Vinci, 32 20132 Milano tel. 02-2087341	A. Isidori Dipartimento di Informatica e Sistemistica Università di Roma Via Salaria, 18 00194 - Roma tel. 06-484441	E. Mosca Dipartimento di Sistemi e Informatica Università di Firenze Via Santa Marta, 3 50139 - Firenze tel. 055-4798338
---	--	---



Rudy Kalman

NEW THEORY OF
SYSTEM
IDENTIFICATION
FROM NOISY DATA



*Poor is the teacher
who is not surpassed
by the students*

Leonardo da Vinci

Automatica 4.0
Elogio dell'automatica

Milano, 11 settembre 2017

Sergio Bittanti