Wednesday, July 17

09.15 - 10.30
Systems Biology - PART I
(F. Blanchini)

10.30 - 11.00
Coffee Break

11.00 - 12.30
Systems Biology - PART II
(F. Blanchini)

12.30 - 14.00
Lunch

14.00 - 15.30
Dynamical system approaches for biology - PART I
(G. Giordano)

15.30 - 16.00
Coffee Break

16.00 - 17.15
Dynamical system approaches for biology - PART II
(G. Giordano)

Thursday, July 18

09.15 - 10.30
Traditional and Deep Learning Approaches to Multi-modal Physiological Data Streams Analysis - PART I
(R. Kamaleswaran)

10.30 - 11.00
Coffee Break

11.00 - 12.30
Traditional and Deep Learning Approaches to Multi-modal Physiological Data Streams Analysis - PART II
(R. Kamaleswaran)

12.30 - 14.00
Lunch

14.00 - 16.00
Assignments and review

16.00 - 16.30
Coffee Break

16.30 - 17.15
Concluding discussion and conclusions

ADMISSION AND ACCOMMODATION

The course is manly addressed to doctoral students on first come first served basis.

The registration fee is 350,00 Euro + VAT taxes*, where applicable (bank charges are not included).

The registration fee includes a complimentary bag, three fixed menu buffet lunches, coffee breaks, downloadable lecture notes and wi-fi internet access.

Applications should be made on-line through our web site: http://www.cism.it/courses/E1901/.
A message of confirmation will be sent to accepted participants.
Information about travel and accommodation is available on our web site, or can be mailed upon request.

A limited number of rooms is available at our Guest House at the rate of Euro 30,00 per person/night.

Applicants may cancel their course registration and receive a full refund by notifying CISM Secretariat in writing (by email) no later than two weeks prior to the start of the course.

If cancellation occurs less than two weeks prior to the start of the course, a Euro 50,00 handling fee will be charged.
Incorrect payments are subject to Euro 50,00 handling fee.

* Italian VAT is 22%.

For further information please contact:
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ACADEMIC YEAR 2019

University of Udine
International Centre for Mechanical Sciences

UNIVERSITÀ DEGLI STUDI DI UDINE

Centro Internazionale
di Scienze Meccaniche
International Centre
for Mechanical Sciences

PRACTICAL SIGNAL AND SYSTEM MODELING FOR HEALTH

CISM-UniUD Joint course
coordinated by

Prof. **Roberto RINALDO**
DPIA, University of Udine

Prof. **Federico FONTANA**
DMIF, University of Udine

Prof. **Alberto POLICRITI**
DMIF, University of Udine

Prof. **Carla PIAZZA**
DMIF, University of Udine

Prof. **Franco BLANCHINI**
DMIF, University of Udine

Udine *July 15 - 18* 2019

PRACTICAL SIGNAL AND SYSTEM MODELING FOR HEALTH

The technological developments that took place during the last decades have made possible an interesting convergence between the disciplines of information technology and of electronic, mechanical and biomedical engineering. One of the most innovative aspects is the collaboration of professionals in the medical field with specialists in the fields of computer processing of data and signals and control, to model, analyze and control complex systems. Examples of such systems include biological systems, such as immune response, relationships with health and mental well-being, the cardiovascular system, and vision mechanisms.

The aim of this course is to present some of the most recent results and techniques concerning signal processing, modeling and analysis of biological systems.

In particular, the most appropriate methodologies for the development of low-consumption sensors for the continuous monitoring of physiological parameters, such as the electrocardiogram, will be considered. In particular, applications of the Compressive Sensing technique will be considered for the separation of fetal beats and for diagnosis in the compressed domain.

One of the most interesting parameters related to electrocardiogram analysis is the study of Heart rate variability (HRV), as it appears to be a potential indicator for autonomic function, prediction of adverse cardiovascular outcomes, psychophysiological status, and general wellness. The course will account for the most recent methods used for preprocessing, windowing, and choosing appropriate analysis parameters.

The course will also present results related to the automatic assessment of neuropsychiatric illness, via the analysis of physiological, behavioral, and psychological changes associated with several related signals, which can be passively monitored using sensors in smartphones, wearable accelerometers, Holter monitors, and multimodal sensing approaches that fuse multiple data types.

The course will also provide fundamental new insights into the emergent behavior of complex biological and embedded systems through the use of revolutionary, highly scalable and fully automated modeling and analysis techniques.

Moreover, the course will present the fundamentals of systems biology, which provides a multi-disciplinary, holistic view over the functioning of biological processes seen as complex systems of dynamically interacting entities. It will also discuss system-theoretic and control-theoretic approaches tailored to get a deeper insight into the dynamic and steady-state behaviour of biological systems, and to help design artificial biomolecular systems with a desired behaviour in synthetic biology. In particular, the huge variability and uncertainty of biological systems will be taken into account to pursue a parameter-free analysis.

LECTURERS

Prof. **Gari Clifford**
Georgia Institute of Technology and Emory University, Atlanta, USA

Dr. **Giulia da Poian**
Emory University, Atlanta, USA

Prof. **Rishikesan Kamaleswaran**
The University of Tennessee Health Science Cente, Memphis, USA

Prof. **Giulia Giordano**
Delft Center for Systems and Control, TU Delft, NL

Prof. **Franco Blanchini**
University of Udine, IT

Prof. **Radu Grosu**
Technische Universität Wien, AT

PROGRAMME

Monday, July 15

08.30 - 09.15
Registration

09.15 - 10.30
Event detection and feature extraction from cardiovascular signals for long term wearables - PART I
(G. Da Poian)

10.30 - 11.00
Coffee Break

11.00 - 12.30
Event detection and feature extraction from cardiovascular signals for long term wearables - PART II
(G. Da Poian)

12.30 - 14.00
Lunch

14.00 - 15.30
Heart rate variability (HRV) as a potential indicator of general wellness: introduction to traditional and novel HRV metrics and to the PhysioNet-Cardiovascular-Signal-Toolbox - PART I
(G. Clifford and G. Da Poian)

15.30 - 16.00
Coffee Break

16.00 - 17.15
Heart rate variability (HRV) as a potential indicator of general wellness: introduction to traditional and novel HRV metrics and to the PhysioNet-Cardiovascular-Signal-Toolbox - PART II
(G. Clifford and G. Da Poian)

To participate in labs, please bring a laptop running a functional copy of Matlab – go to https://www.mathworks.com/academia/student-competitions/physionet.html# to request a complimentary copy of Matlab (to also use in this year PhysioNet/CinC Challenge: https://www.physionet.org/challenge/)

Tuesday, July 16

09.15 - 10.00
Does the body rule the mind or does the mind rule the body? An activity toolbox to complement the HRV toolbox. - PART I
(G. Clifford)

10.00 - 10.30
Coffee Break

10.30 - 12.30
Does the body rule the mind or does the mind rule the body? An activity toolbox to complement the HRV toolbox. - PART II
(G. Clifford)

12.30 - 14.00
Lunch

14.40 - 15.30
Methods for the analysis of complex biological and embedded systems - PART I
(R. Grosu)

15.30 - 16.00
Coffee Break

16.00 - 17.15
Methods for the analysis of complex biological and embedded systems - PART II
(R. Grosu)