

Seminar Labex MS2T  
“Control of Technological Systems of Systems”

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## Computational fluid dynamics modelling and congenital heart diseases

### Abstract:

Treatment of congenital heart diseases has been evolving rapidly in recent years, requiring customized therapies due to the large inter-patient variability of anatomical and hemodynamic parameters within the vascular arrangement following a surgical repair. Nowadays, virtual surgery based on computational fluid dynamics or in silico patient-specific modelling is a promising tool because it could help surgeons in the decision-making process, improving and understanding hemodynamic outcomes and reducing trial errors during complex surgeries. Indeed, mathematical modelling is a powerful tool to investigate haemodynamics of the circulatory system. With the improving in the imaging techniques, nowadays, it is possible to build patient-specific models of congenital malformations and surgeries for the treatment of congenital heart diseases. These models can help clinicians in better understanding the hemodynamic behaviour of different surgical options for a treated patient. This presentation is partially based on the work under way within the Transatlantic Project ‘Multi-scale modeling of single ventricle hearts for clinical decision support’, funded by Fondation Leducq (Paris). It will outline how mathematical models have improved in the recent years, which are the limitations still present and which are the future directions in this area.

### Short Bio:



Gabriele Dubini received his MSc in Mechanical Engineering cum laude in 1988 and his PhD in Bioengineering in 1993 from Politecnico di Milano, Milan, Italy. In 1993 and 1994 he worked as a Research Assistant in the Cardiothoracic Unit of Great Ormond Street Hospital for Children - NHS Trust in London, UK. From 1996 to 2001 he was an Assistant Professor of Thermodynamics and Heat Transfer at the Energy Engineering Department of Politecnico di Milano. From 2001 to 2007 he was an Associate Professor in Industrial Bioengineering at the Department of Structural Engineering of Politecnico di Milano. Since 2007 he has been a Full Professor in Bioengineering at the Department of Structural Engineering and, since

1 January 2013, at the Department of Chemistry, Materials and Chemical Engineering ‘Giulio Natta’. From 2003 to 2007 he was the Director of the Laboratory of Biological Structure Mechanics (LaBS) of Politecnico di Milano. He was a member of the Scientific Panel of the Coordination Centre on NanoBiotechnologies and Nanomedicine at Politecnico di Milano from 2007 to 2012. He has been serving as a project reviewer and as a proposal evaluator for the European Commission for the theme ICT - Information and Communication Technologies since 2006. From 2008 to 2012 he was a member of the Council of the European Society of Biomechanics (ESB) and the Secretary-General for the 2010-12 biennium. His major research activities have included the microcirculation, the virtual planning of paediatric cardiac surgery procedures, the design and characterisation of endovascular devices and microfluidic devices for biomedical applications.