

---

## Seminar

# Advanced Design Theories and Technology for Complex Systems (2):

### 1. Introduction and Parametric CAD

September 5, 2012

### 2. KBE and Design Automation

September 6, 2012

### 3. New application on Prosthesis Design and Aneurism

Prediction

September 7, 2012



**Lecturer**

Prof. Giorgio Colombo Politecnico di Milano, Italy

## Sponsor

International Collaboration Innovation Team Project of Tsinghua University

(重点学科高水平国际合作创新团队支持项目)

## Organizer

Institute of Design Engineering

Tsinghua University

<http://adcp2012.com>

---

## Introduction to the lecturer



### **Giorgio Colombo, Associate Professor, Politecnico di Milano, Italy**

Prof. Giorgio Colombo is associate professor at Politecnico di Milano. In 1989, he started his research activities at ITIA-CNR in Milan. From 1992 to 2000, he has been assistant professor at Faculty of Engineering of Parma. Since 2001 he has been associate professor. His research activities focus on: shape modelling, Knowledge Based Engineering, Computer Aided Design, Simulation techniques, Computer Graphics, Virtual Reality, robotics. He has been coordinator and responsible for the research unit activities in national and European research projects.

#### **Selected Publications**

- Colombo G., Cugini U. e Ferretti D., (1989) How to Represent Design Rules in a Parametric CAD System, In: Proceeding International Symposium on Advanced Geometric Modelling for Engineering Applications, Berlin, 8-9 Novembre, 1989, pp.271-282.
- Colombo G., Girotti A., Rovida E., (2005) Automatic Design of Hydraulic Press Brake for Sheet Metal Bending, In: Proceeding ICED 2005, Melbourne, 15-18 August 2005.
- Pugliese D., Colombo G., Spurio M. (2007) About the integration between KBE and PLM, In: Proceeding Advances in Life Cycle Engineering for Sustainable Manufacturing Businesses - Proceedings of the 14th CIRP Conference on Life Cycle Engineering , pp. 131-136.
- G. Colombo, D. Pugliese, and C. Rizzi, (2008). Developing DA Applications in SMEs Industrial Context, Computer Aided Innovation (CAI), WCC 2008, Ed. G. Cascini, Springer, pp.69-82. ISBN 978-0-837-09696-4.
- Colombo G., Gabbiadini S., Facoetti G., Rizzi C. (2009). Knowledge management and customized 3D modeling to improve prosthesis design. In: Proceedings ASME 2009 International Design Engineering Technical Conferences & Computers and Information in Engineering Conference. San Diego (California) U.S.A., 30 Agosto - 2 Settembre, 2009, vol. CD-ROM, ISBN/ISSN: ISBN 978-0-7918-3856-3.
- Colombo G., Filippi S., Rizzi C., Rotini F. (2010). A new design paradigm for the development of custom-fit soft sockets for lower limb prostheses. Computer in Industry, ISSN: 0166-3615, doi: 10.1016.
- Colombo G., Facoetti G., Gabbiadini S., Rizzi C. (2010). Knowledge-based system for guided modelling of sockets for lower limb prostheses, Computer Aided Design and Applications, 7 (5), pp. 723-737 ISSN: 1686-4360.

---

Colombo G., Rizzi C., Scotto M. (2011). A knowledge based application to enhance fired heater design. *Research in Interactive Design*. vol. 3, Springer-Verlag, ISBN/ISSN: 978-2-8178-0168-1

Colombo G., Facoetti G., Morotti R., Rizzi C. (2011). Physically Based Modelling and Simulation to Innovate Socket Design. *Computer Aided Design and Applications*, vol. 8(4); p. 617-631, ISSN: 1686-4360.

Bartesaghi S., Colombo G., (2012) Effectiveness of simulations in decision making: preliminary studies on Computational fluid dynamics as a tool for aneurism diagnosis and therapy, In: *Proceedings of TMCE 2012*, Edited by I. Horváth, A. Albers, M. Behrendt and Z. Rusák, May 7–11, 2012, Karlsruhe, Germany.

### **Introduction to the lectures**

Title: “An introduction to Knowledge Engineering and Design Automation”

Contents:

1. Knowledge, Product Development and Information Technology
2. Parametric CAD and Design Rules representation
3. The birth of KBE: Object-oriented modeling and Product Development
4. MEDEA: a methodology to collect and formalize knowledge and develop DA applications
5. Knowledge Engineering applied to not-industrial problems
6. Open issues in Knowledge Engineering (knowledge and PLM, new IT tools, ...)
7. Conclusions

### **References:**

Colombo G., Rizzi C., Scotto M. (2011). A knowledge based application to enhance fired heater design. *Research in Interactive Design*. vol. 3, Springer-Verlag, ISBN/ISSN: 978-2-8178-0168-1

G. Colombo, D. Pugliese, and C. Rizzi, (2008). Developing DA Applications in SMEs Industrial Context, *Computer Aided Innovation (CAI), WCC 2008*, Ed. G. Cascini, Springer, pp.69-82. ISBN 978-0-837-09696-4.

G. Colombo, D. Pugliese, and C. Rizzi, (2008). Developing DA Applications in SMEs Industrial Context, *Computer Aided Innovation (CAI), WCC 2008*, Ed. G. Cascini, Springer, pp.69-82. ISBN 978-0-837-09696-4.

Colombo G., Facoetti G., Gabbiadini S., Rizzi C. (2010). Knowledge-based system for guided modelling of sockets for lower limb prostheses, *Computer Aided Design and Applications*, 7 (5), pp. 723-737 ISSN: 1686-4360

Giorgio Colombo, Stella Gabbiadini, Daniele Regazzoni, Caterina Rizzi, Design Procedure And Rules To Configure Lower Limb Prosthesis, *Proceedings of the ASME 2011 International Design Engineering Technical Conferences & Computers and Information in Engineering Conference, IDETC/CIE 2011*, August 29-31, 2011, Washington, DC, USA

Giorgio Colombo and Ferruccio Mandorli, Evolution in Mechanical Design Automation and Engineering Knowledge Management, In *Innovation in Product Design, From CAD to Virtual Prototyping*, Bordegoni M. and Rizzi C. (Eds.), 1st Edition, 2011.

---

## Program

### **September 5, 2012, Introduction and Parametric CAD**

Morning session: 9.00-11.45 am

1. Knowledge, Product Development and Information Technology
2. Parametric CAD and Design Rules representation

Afternoon session: 1.30-4.45 pm

1.30-4.00 pm, reading reference materials. Examples and cases discussion on parametric CAD and design rules (SolidWorks/SolidEdge + Excel)

4.00-4.45 pm, discussion

### **September 6, 2012, KBE and Design Automation**

Morning session: 9.00-11.45 am

1. The birth of KBE: Object-oriented modeling and Product Development
2. MEDEA: a methodology to collect and formalize knowledge and develop DA applications

Afternoon session: 1.30-4.45 pm

1.30-4.00 pm, reading reference materials. Examples on knowledge collecting and formalization (mind map, IDEF, UML)

4.00-4.45 pm, discussion

### **September 7, 2012, New application on Prosthesis Design and Aneurism Prediction**

Morning session: 9.00-11.45 am

1. Knowledge Engineering applied to Rehabilitation Engineering
2. Open issues in Knowledge Engineering (knowledge and PLM, new IT tools, ...)
3. Conclusions

Afternoon session: 1.30-4.45 pm

1.30-4.00 pm, reading reference materials. Examples and discussion on cases related to points 5 and 6

4.00-4.45 pm, discussion

### **Contact**

Prof. Giorgio Colombo: Giorgio, Politecnico di Milano, Italy

Email: colombo@mecc.polimi.it

Dr. Hou Yuemin

Institute of Design Engineering, Precision Instruments and Mechanology Department

Tsinghua University, Beijing 100084, China

Tel: 8610-62773470, hym01 at mails.tsinghua.edu.cn

---

## Index

How to Represent Design Rules in a Parametric CAD System	1
Evolution in Mechanical Design Automation and Engineering Knowledge Management	18
About the integration between KBE and PLM	41
Developing DA Applications in SMEs Industrial Context	48
A knowledge based application to enhance fired heater design	65
Knowledge-based system for guided modelling of sockets for lower limb prostheses	73
Embedded CFD Simulation for Blood Flow	80
Design Procedure And Rules To Configure Lower Limb Prosthesis	94

