

COMPUTERS IN THE CLASSROOM: MODELING AND SIMULATION IN THE SCIENCES

Robotica e innovazioni nell'educazione

Modena, 18-19 novembre 2013, Museolaboratorio di Officina Emilia

Federico Corni

**Department of Education and Humanities
University of Modena and Reggio Emilia**

Hans U. Fuchs

**IAMP – Institute of Applied Mathematics and Physics
ZHAW – Zurich University of Applied Sciences at Winterthur**

MODELING AND SIMULATION OF NATURAL AND TECHNICAL SYSTEMS

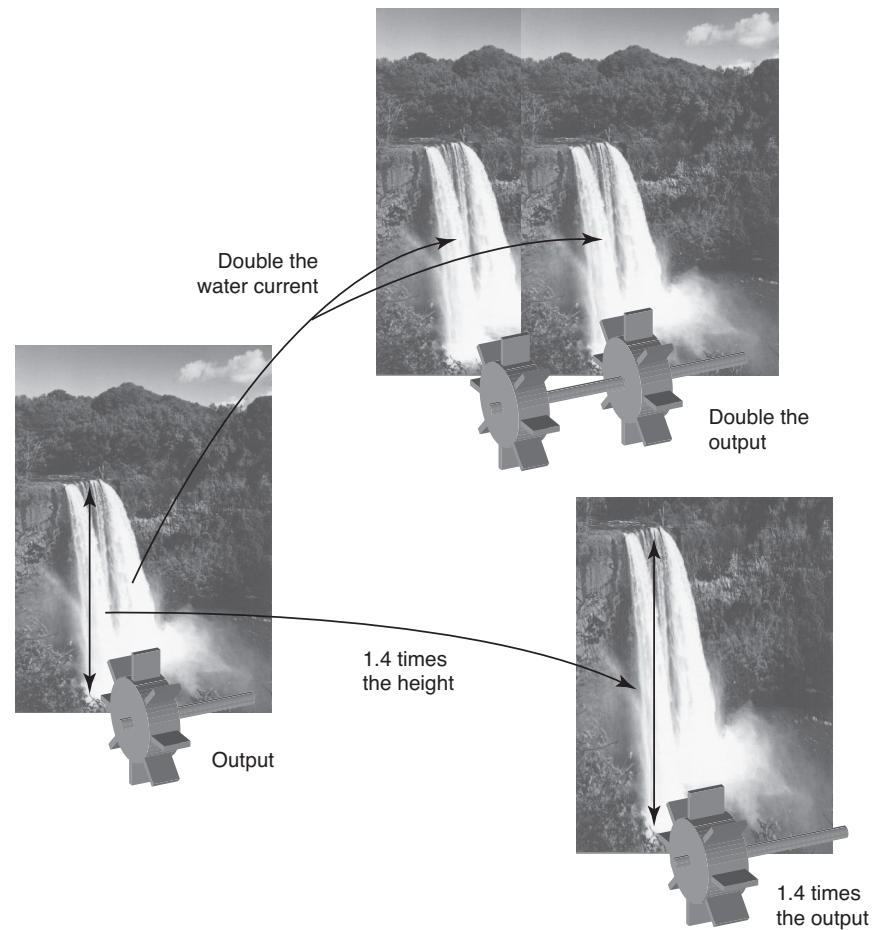
GENERAL GOAL FOR THIS TALK

- We would like to discuss approaches to modeling and simulation of (dynamical) natural and technical systems for students at different ages and levels of education

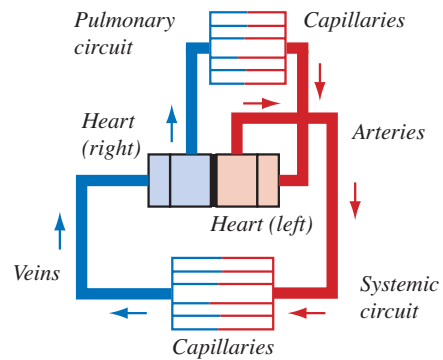
SOME THESES

- Graphical Modeling Tools (GMTs) make modeling possible for many types of students
- Intuitive knowledge (fundamental understanding) goes before formal ability (the use of mathematics or programming languages)
- Figures of mind for understanding nature and machines serve as mind-tools for modeling

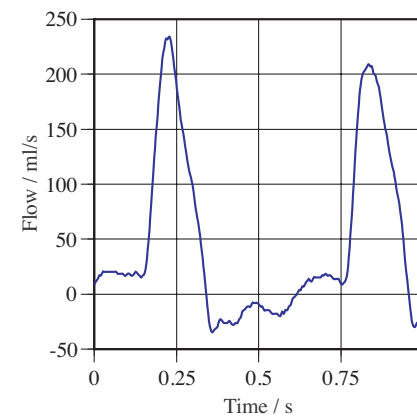
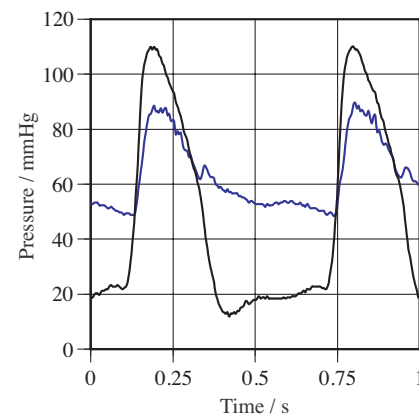
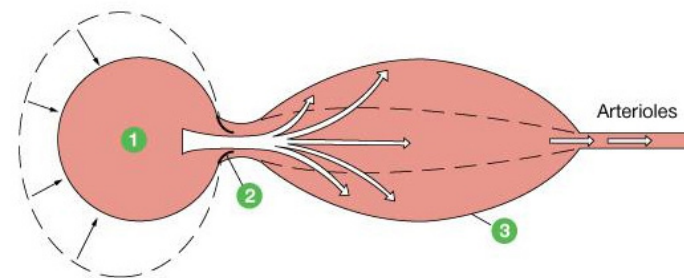
SIMULATING ENERGY RELATIONS IN PRIMARY SCHOOL



A SCIENCE PROJECT IN UNIVERSITY: MODELING AND SIMULATION OF THE BLOOD CIRCULATORY SYSTEM 1

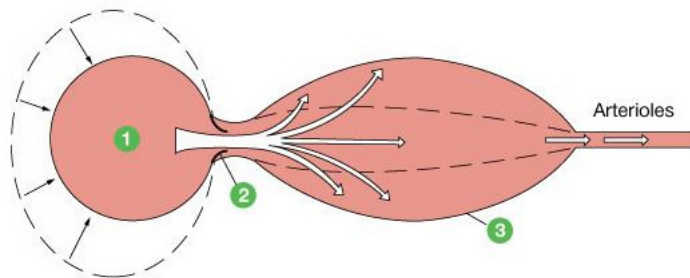


(a) Ventricular contraction



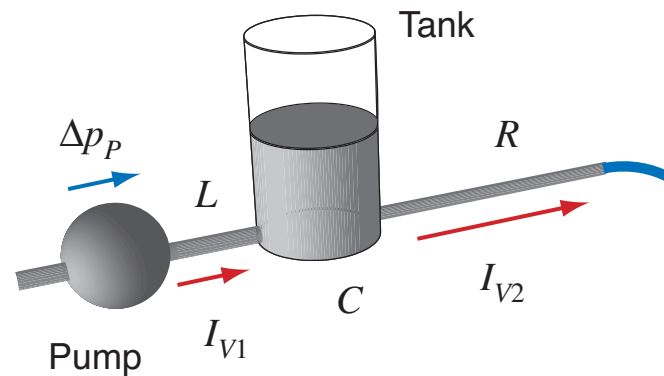
A SCIENCE PROJECT IN UNIVERSITY: MODELING AND SIMULATION OF THE BLOOD CIRCULATORY SYSTEM 2

(a) Ventricular contraction

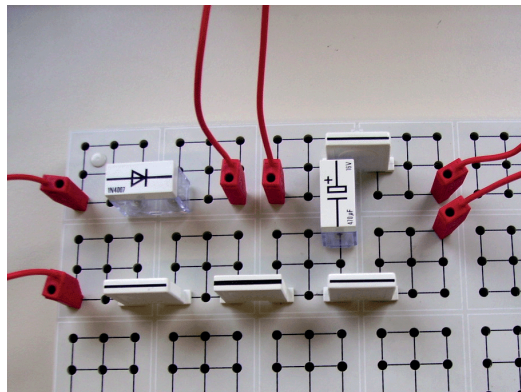


Reality...

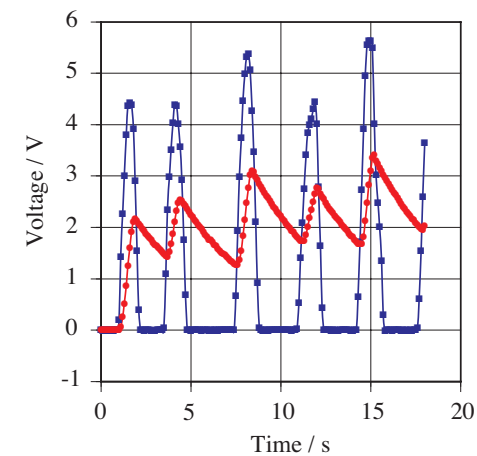
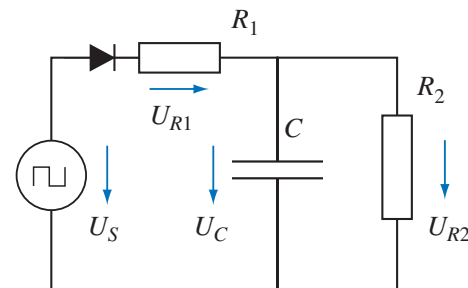
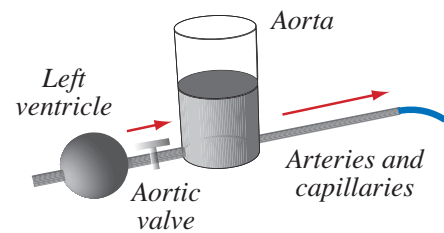
A windkessel model...



A SCIENCE PROJECT IN UNIVERSITY: MODELING AND SIMULATION OF THE BLOOD CIRCULATORY SYSTEM 3

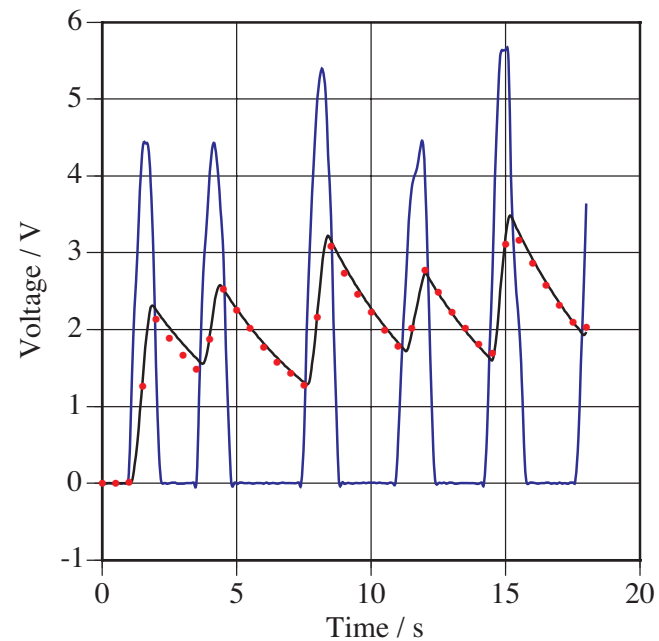
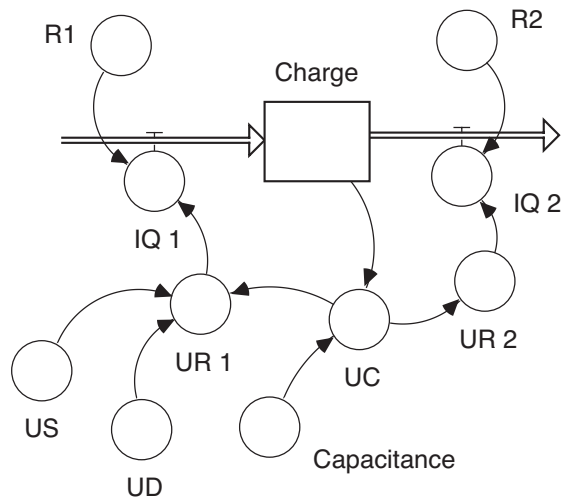


A second mapping to a physical model...

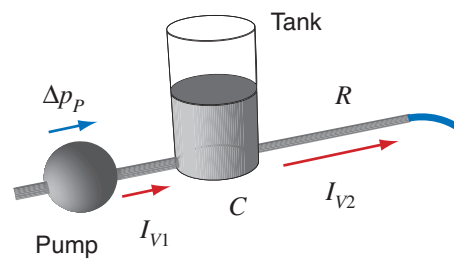


A SCIENCE PROJECT IN UNIVERSITY: MODELING AND SIMULATION OF THE BLOOD CIRCULATORY SYSTEM 4

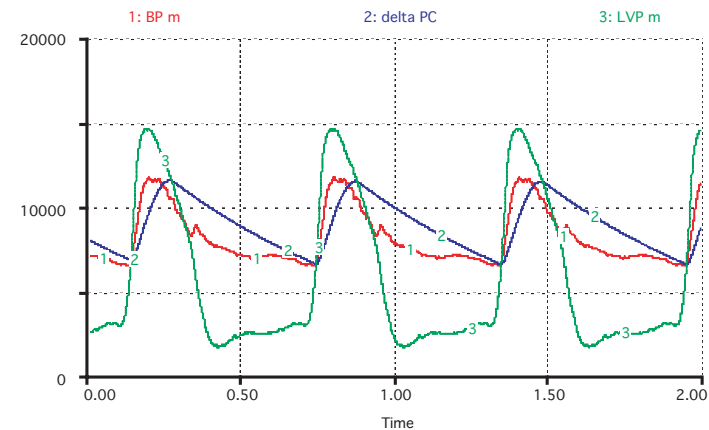
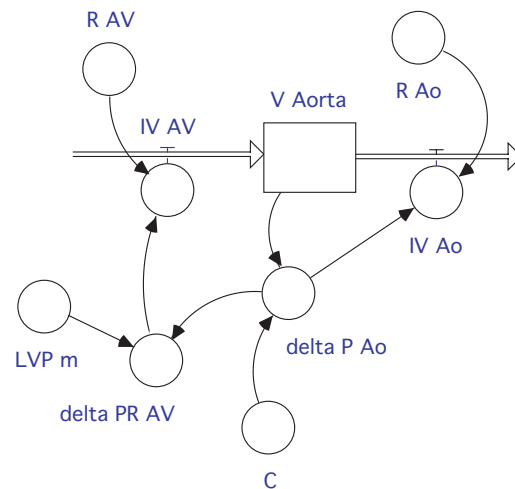
*A third mapping to a dynamical
computer model of the physical
model (electric circuit)...*



A SCIENCE PROJECT IN UNIVERSITY: MODELING AND SIMULATION OF THE BLOOD CIRCULATORY SYSTEM 5

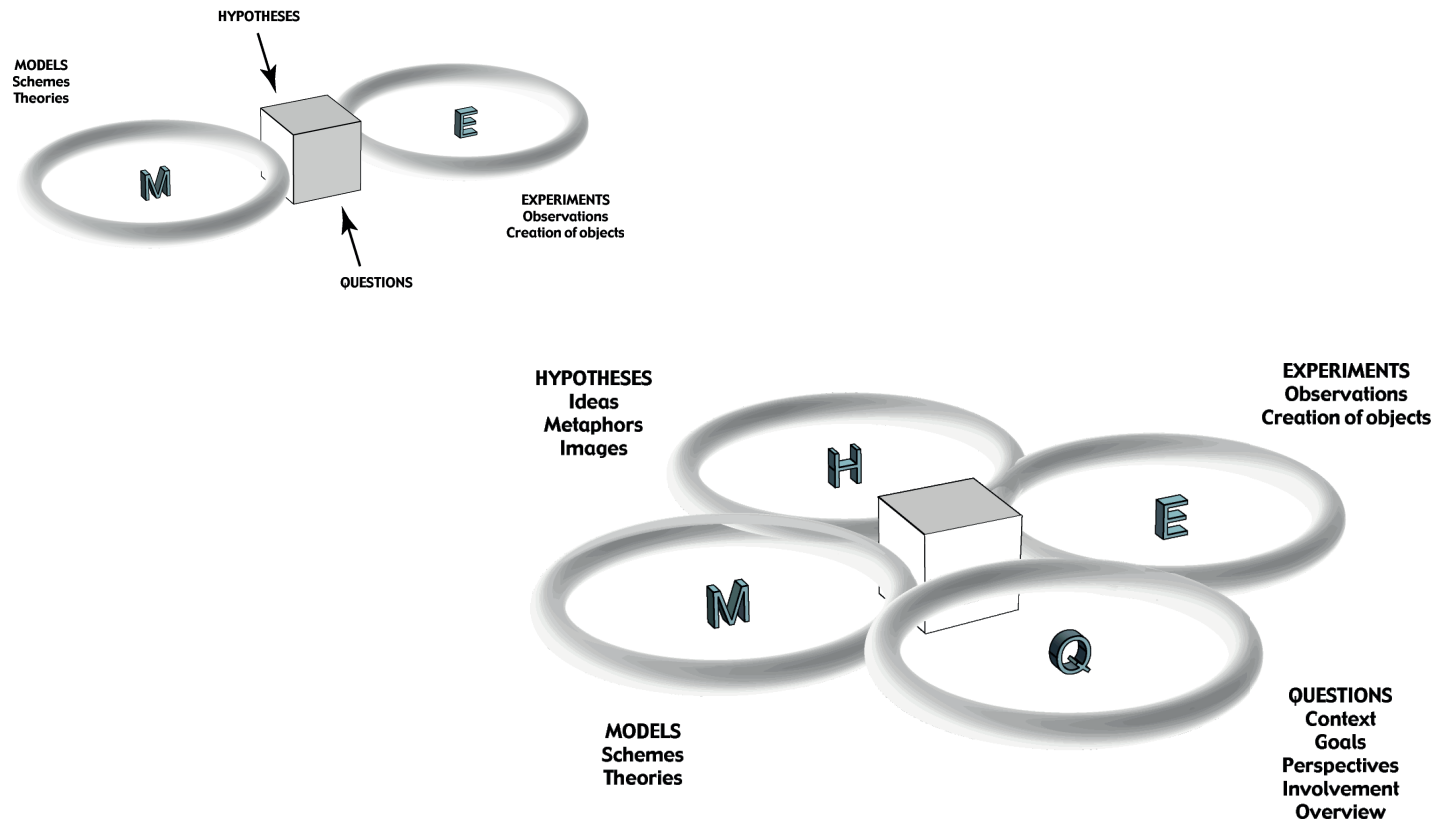


*A fourth mapping to a dynamical
computer model of the hydraulic
windkessel...*



*...and comparison of
simulation and data.*

MODELING AND SCIENTIFIC METHODS: THE FOUR-CYCLE



CONCLUSION

The use of computers and software having **GMTs for explicit modeling and simulation** of real life systems can change the face of education.

An important ingredient to any such endeavor is the identification and proper use of **figures of mind** as mind-tools for modeling.