ETC-3: Hierarchical Energy-based Modeling

About this course	
The course describes an energy based modeling approach to deal with coupled systems from different physical domains that act on widely different scales. Each physical system is modeled via a model hierarchy (ranging from detailed models for simulation to reduced models for control and optimization) of port-Hamiltonian systems. The systems are coupled via a network of uni-physics nodes coupled via power conserving interconnections so that the full system stays port-Hamiltonian. Using this very flexible approach, it is possible to control the accuracy of each component separately and to the need of the application. Error controlled model reduction and Galerkin projection as in Finite Element Modeling work in an analogous way. As real world test cases models from gas transport optimization, power grid modeling, or acoustic field simulation are discussed.	
Location	Technische Universität Berlin, Germany
Dates	27 August - 31 August 2018
Length	1 week
Evaluation	The course will conclude with oral exams or a written test depending on the number of participants.
Credits	4 ECTS
Language	English
Course structure	**Module 1:** Energy based modeling with port-Hamiltonian systems **Module 2:** Analytic and algebraic properties of port-Hamiltonian systems **Module 3:** Port-Hamiltonian differential-algebraic systems **Module 4:** Model hierarchies and model adaptivity **Module 5:** Model reduction via Galerkin projection
Lecture	Prof. Volker Mehrmann (TU Berlin/MATHEON)
Organization	The course will consist of 20 lectures (each 45 min) plus 8 exercise sessions (each 45 min) including practical sessions using MATLAB. Groups of up to 3 people perform the exercises.

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