Energy-based control of distributed port-Hamiltonian systems

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The scope of this talk is to present a general methodology for the synthesis of asymptotic stabilizing boundary control laws for a large class of linear, distributed port-Hamiltonian systems defined on a one-dimensional spatial domain. The starting point is the control by interconnection paradigm (energy-Casimir method) in which the controller is a passive dynamical system that is interconnected to the boundary of the distributed parameter one. Despite the intrinsic limitations of the approach related to the class of systems to which the method is applicable, it is shown that the control action is able to shape the closed-loop Hamiltonian to obtain desired stability properties. These considerations lead to the development of a more general approach based on state feedback able to perform the energy-shaping task even for system with strong dissipation. The idea is to obtain a closed-loop system still in port-Hamiltonian form, but characterized by a new Hamiltonian with a unique and isolated minimum at the desired equilibrium. Asymptotic stability is then obtained via damping injection on the boundary. The general theory is illustrated with the help of some examples.