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NUMERICAL SIMULATION OF ENERGY HARVESTING DEVICES DRIVEN BY FLUID-STRUCTURE INTERACTION

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Summary: A specific class of piezo-electric energy harvesting devices for renewable energy resources is investigated. The key idea is to invert the traditional intention of engineers to avoid flow-induced excitation of structures such, that flow-induced vibrations can successfully be controlled and utilised in order to provide independent power supply to small-scale electrical devices. Possible application are e.g. micro electro-mechanical systems, monitoring sensors at remote locations or even in-vivo medical devices with the advantage of increased independence on local energy storage and reduced maintenance effort.

This energy converter technology involves transient boundary-coupled fluid-structure interaction, volume-coupled piezo-electric-mechanics as well as a controlling electric circuit simultaneously. In order to understand the phenomenology and to increase robustness and performance of such devices, a mathematical and numerical model of the transient strongly-coupled non-linear multi-physics system is developed for systematic computational analyses.

On basis of numerical investigations of the overall system optimal designs of the flow-induced vibrating piezo-electric energy harvester shall be identified with respect to electric power supply under varying exterior conditions. Vortex-induced excitations of a cantilever piezo-electric plate are exemplarily considered for studies on robustness and efficiency.