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ANALYSIS OF FSI-DRIVEN ENERGY HARVESTING DEVICES USING PARAMETERISED REDUCED-ORDER MODELS

A. Zilian[1,*] and D. Baroli[1]

[1] Institute of Computational Engineering, FSTC, University of Luxembourg, Luxembourg
[*] Corresponding author: andreas.zilian@uni.lu

A specific class of energy harvester devices for renewable energy resources allows conversion of ambient fluid flow energy to electrical energy via flow-induced vibrations of a piezo-ceramic composite structure positioned in the flow field. This energy converter technology simultaneously involves the interaction of a composite structure and a surrounding fluid, the electric charge accumulated in the piezo-ceramic material and a controlling electrical circuit. In order to predict the efficiency and operational properties of such future devices and to increase their robustness and performance, a mathematical and numerical model of the complex physical system is required to allow systematic computational investigation of the involved phenomena and coupling characteristics.

The presentation will discuss a monolithic modelling approach that allows simultaneous analysis of the harvester, which involves surface-coupled fluid-structure interaction, volume-coupled electro-mechanics and a controlling energy harvesting circuit. Based on a finite element discretisation of the weighted residual form of the governing equations, time- and frequency-domain analysis enables investigation of different types of structures (plate, shells) subject to exterior/interior flow with varying parameters, and attached electrical circuits with respect to the electrical power output generated. Consequently, options for parametric reduced-order modelling of flow-driven energy harvesters will be discussed.

References

[1] S. Ravi, A. Zilian, Time and frequency domain analysis of piezoelectric energy harvesters by monolithic finite element modeling, Int. J. for Numerical Methods in Engrg, 112(12):1828–1847, 2017.

[2] S. Ravi, A. Zilian, Monolithic modeling and finite element analysis of piezoelectric energy harvesters, Acta Mechanica, 228(6):2251–2267, 2017.

[3] S. Ravi, A. Zilian, Numerical Modeling of Flow-Driven Piezoelectric Energy Harvesting Devices, in: Computational Methods for Solids and Fluids, Springer, 2016.