DESCRIPTION FOR THE GENERAL PUBLIC

The main goal of this project is to build a framework for accurate, integrated two-way coupling modelling of an active electro-mechanical system including a nonlinear constitutive piezoelectric material law as well as enhanced electric field distribution. The proposed mathematical model of the structure will consider an integrated smart structural system as a whole by adding additional terms representing dynamic properties of the system control unit. The developed analytical model should be ready for general purpose analysis of active systems incorporating full dynamics of a master structure as well as control sub-system dynamics.

At first the elaborated model will be implemented to study composite structures dynamics taking into account various cross-sections and reinforcing fibres placement which may lead to selected mode couplings. The second application is a rotating beam structure composed of a hub and two or three flexible beams. The Partial Differential Equations (PDEs) will be derived on the basis of the extended Hamilton's principle of least action, considering two-way coupling of electrical and mechanical fields and a moving coordinates frame. The resonance curves, bifurcation and stability analysis characteristics will be presented and compared to the result available in the literature. The elaborated model will be validated experimentally for selected cases and dynamics of the rotor will be checked when the voltage to the active PZT element is supplied. Then, the model will be used to design control strategy in order to reduce vibrations of the blades.

The project will develop a few scientific areas: nonlinear mechanics, electrical engineering, control, mathematical and numerical methods. Results can be used in the future for mechanical or aerospace structures.