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DESIGN OF CONTROL CONCEPTS FOR A SMART BEAM STRUCTURE WITH REGARD TO SENSITIVITY ANALYSIS OF THE SYSTEM

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Summary: A smart structure is a structure which can reduce the structural vibration by integration of sensor, actuator, and controller. The sensor detects the vibration of the beam and transfers the signal to the actuator via a controller. Then the actuator gives a voltage to compensate the beam's vibration. A piezoelectric patch is often used as the sensor and actuator in a smart structure, so is in this research project. With a proper designed controller a smart structure can reduce its vibration without changing the structure's geometer. As a smart structure has more components in comparison to a passive structure, it can contain more uncertainties. Therefore, a smart structure should be well analyzed to ensure its reliability and robustness. Sensitivity analysis is a method to quantitatively describe the system's behavior. This paper explains how to build a numerical model of a smart beam structure and design the control concepts for it with regard to the sensitivity analysis of this system. To carry out the sensitivity analysis, the parameters of the smart structure will be varied in a small deviation and build up thousands of variations. The difficulties arise on the definitions of the parameters in controller to meet the requirements of thousands of variations. At first this paper would interpret briefly, how to build up a finite element (FE) model of this coupled system. Following is the model reduction according to the Krylov Subspace Method. The next step, and also the kern of this paper, is design of control concepts based on the reduced model. Not only model based control concept but also non-model based control concept will be discussed in this paper to compare their performances. The Bode-diagram and the step response of the structure are used to proof the performances of the controllers.