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Chapter 1 : CiteSeerX â€” Optimization Strategies for Sensor and Actuator Placement

give examples from the literature of actuator and sensor placement problems, will examine common features in these problems, and will describe combinatorial optimization methods used for solving them.

This is an open access article distributed under the Creative Commons Attribution License , which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited. Abstract This paper states an approach to actuator and sensor positioning optimization and design in the control system design of a large blended wing body BWB passenger aircraft. Numerous objectives have to be achieved by the control system: Exploiting the system structure and existing system knowledge excitation, comfort, and load formulations , evaluation criteria are designed to assess actuator and sensor effectiveness and efficiency for the aircraft dynamic range of interest. The tasks of optimal actuator and sensor positioning, actuator sizing, and actuator bandwidth requirements are investigated, whereby solutions that are robust are sought with respect to parameter variations. The results are shown on a BWB passenger aircraft model and verified using a normalized closed-loop performance assessment approach. Introduction The high complexity of a large-scale system design procedure, such as the control system design of a passenger aircraft, is challenging. The modeling issues are manifold, also involving the interdependence of design decisions and the lack of perfect model information in the design process. In this work, a part of control system design performed within the predesign stage of a large blended wing body BWB passenger aircraft see Figure 1 is reported: Also the related evaluation and system design methods are proposed. This task is comprised of gathering and formulating control design objectives, defining the scope and methods of optimization, choosing appropriate design weights to incorporate excitations and performance objectives, and finally computing optimization results and interpreting them with respect to the system design tasks. Large-scale blended wing body BWB passenger aircraft. The special properties of flexible structure systems are described in detail in [2]. Fundamental properties of multi-input multi-output MIMO control systems and state space system calculus are presented in [3]. More recent sources are given by [2 , 5 , 6]. The evaluation criteria proposed in [2 , 6] assess state controllability and observability in a weighted sense. They are combined into a recently proposed criterion to exploit their individual advantages [7]. Experimental results of actuator and sensor positioning optimization are given in [6 , 8 â€” 10] for Piezo actuators and strain sensors. In actuator positioning, the task is typically to find those actuators out of a set of candidates which robustly maximize a controllability-related measure. Optimally positioned sensors can, in turn, be defined by their optimal capability to detect structural behavior. In this work, this is required in all relevant operating points of the aircraft. In this sense, a robust placement of actuators and sensors has to be obtained. This is even more important as the dynamic properties of the aircraft change strongly across the admissible parameter range. For the present study, a multimodel approach has been employed, using a set of models with two varying parameters: The remainder of this work is organized as follows. First, the well-known modal modeling approach for flexible structures is outlined in Section 2. Then, the utilized aircraft model is presented in Section 4. Finally, the design tasks are carried out on the aircraft model and the results are collected in Section 5 , concluded by final remarks and an outlook to future work.

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Chapter 2 : Formats and Editions of Optimization strategies for sensor and actuator placement [blog.quinto

This paper provides a survey of actuator and sensor placement problems from a wide range of engineering disciplines and a variety of applications. Combinatorial optimization methods are recommended as a means for identifying sets of actuators and sensors that maximize performance.

Show Context Citation Context While many of these studies use genetic algorithms sometimes simulated annealing , they focus on structure rather than mechanism motion transmission problems. Several researchers have investigate Sensor placement optimization under uncertainty for structural health monitoring systems of hot aerospace structures by Robert Frank Guratzsch " Sankaran Mahadevan â€" for his constant support throughout my career at Vanderbilt University. I thank him for his encouragement, constructive criticism, and belief in my abilities. I thank him especially for his I thank him especially for his patience during the countless hours we spent working together. I also wish to thank the members of my committee, Dr. Gautam Biswas, and Dr. Mark Ellingham, for their advice and great attitude toward working with me. Guratzsch, Sankaran Mahadevan " This paper develops a methodology for the optimum layout design of sensor arrays of structural health monitoring SHM systems under uncertainty. This includes finite element analysis under transient mechanical and thermal loads and incorporation of uncertainty quantification methods. The finite element model is validated with experimental data, accounting for uncertainties in experimental measurements and model predictions. The SHM sensors need to be placed optimally in order to detect with high reliability any structural damage before it turns critical. The proposed methodology achieves this objective by combining probabilistic finite element analysis, structural damage detection algorithms, and reliability-based optimization concepts. Continued progress to reduce fan noise emission from high bypass ratio engine ducts in aircraft increasingly relies on accurate description of the sound propagation in the duct. This is a two-pronged approach, including development of analytic models the subject of a separate paper and installation of a laboratory-quality test rig. The purposes of the rig are to validate the analytical models and to evaluate novel duct acoustic liner concepts, both passive and active. The duct is of rectangular cross section so as to provide flexibility to design and fabricate test duct liner samples. The test section can accommodate flow paths that are straight through or offset from inlet to discharge, the latter design allowing investigation of the effect of curvature on sound propagation and duct liner performance. The maximum air flow rate through the duct is Mach 0. Sound in the duct is generated by an array of 16 high-intensity acoustic drivers. The sound is sampled by arrays of flush-mounted microphones and a modal decomposition is performed at the frequency of sound generation. The data acquisition system consists of two arrays of flush-mounted microphones, one upstream of the test section and one downstream.

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A method based on Fisher Information from sensitivity matrix is presented for sensor placement innondestructive tests used for parameter stimation and structural model updating using sparse and noisy measurements.

Chapter 4 : Actuator and Sensor Positioning Optimization in Control Design for a Large BWB Passenger A

not actually address the placement of sensors and actuators of ï¬•xed precision, but rather assigns a cost associated with the precision of the sensors and actuators used (in preas- signed locations), then optimizes these precisions in order to minimize this cost.