

Plenary Lectures



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Title

Characteristic Modeling Theory and its Applications in Rendezvous and Docking Control

Abstract :

A key ingredient that connects control theory to its application is modeling of the plant to be controlled. Mathematics based control theory often encounters difficulties when applied to practical engineering problems due to the inadequate exploitation of the characteristics of the plant to be controlled. This motivates the study of engineering based control theory. Along this direction, Professor Hongxin Wu initiated the characteristic modeling approach in the 1990s, and many researchers have been focusing on its development and applications since then. This modeling approach takes into account both the dynamic characteristics of the plant to be controlled and the performance specifications of the control system, while the traditional modeling method only seeks modeling accuracy as high as possible. Thus, it can be considered as a control oriented modeling approach. In this talk, we give an introductory overview of characteristic modeling and characteristic model based control. First, we review its basic concept, key features, and underlying mechanism. Then, we overview the controller design process based on characteristic model. In order to demonstrate the practicability of characteristic model and the superior performance of the closed-loop control system under characteristic model based control, we introduce its successful applications in several engineering problems (e.g., adaptive re-entry lifting control of manned spacecraft, control of the aluminum electrolysis process, adaptive control of spacecraft instantaneous thermal current, attitude control of spacecraft with deployable and retractable structures, and stabilization of a high speed rotor suspended on active magnetic bearings), and in particular we provide in detail its applications in the automatic rendezvous and docking between Shenzhou spacecraft (including Shenzhou-8, Shenzhou-9, and Shenzhou-10) and Tiangong-1. At the end of this talk, we discuss several future research topics and prospects concerning characteristic modeling theory.