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LYAPUNOV STABILITY ANALYSIS OF SPACECRAFT ATTITUDE CONTROL SYSTEM WITH CONTROL ALLOCATION

Abstract

Control allocation considers the problem of controlling instruction distribution for control systems with multiple, redundant controls. The control system design is divided into controller design and allocation algorithm design since control allocation emerges. Controller design generates desired moments driving the system to move as expected, whereas allocation algorithm design generates the instructions of each control according to the desired moments, making the achieved moments close as possible to the desired moments. When performing controller design, the stability performance of the control system must be guaranteed. However, the performance may be breached because of tracking errors produced by the allocation algorithm when the achieved moments are incapable of following the desired moments. It is hence necessary to analysis the stability of the control system with controller and control allocation. Attention of this paper is confined to solve the problem in the attitude control system of spacecraft using Lyapunov stability theory. The sliding mode control method with input saturation would be used in the controller, while in the control allocation, the direct allocation method and the pseudo-inverse method, indicate two sorts of allocation methods, would separately be analyzed. The direct allocation method generates errors only when the desired moment lies outside of the attainable moment set, which is composed of all the attainable moments that the controls could generate under their constraints. The pseudo-inverse method generates errors whatever the desire moment lies in or out of the attainable moment set. Conclusions of analyzing control system with the two methods would be compatible with other allocation methods having the same performances with them. Finally, some simulation results would be presented in the last part of the paper.