Analysis and Design of Control Systems Operating in Fuzzy Environments using Consolidity Charts

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ABSTRACT

Consolidity is the inner property which explains why stable and controllable systems expose to failure. Consolidity chart is that it marks the boundary of all system interactive behavior resulting from all exhaustive fuzzy internal and external influences. In this thesis, two mathematical methods are proposed for automatic construction of the minimum area consolidity region (chart) under the condition of passing the major axis of ellipse through origin. The shape and size of each consolidity geometric region determine how the feature of system susceptibility to change. Approximated results for drawing the consolidity region were obtained earlier as found in literature because it was done by a heuristic method that depends on sense rather than deterministic mathematical technique. The proposed techniques being dependent on mathematical and optimization rules, is proven to give exact reliable results as will be demonstrated later. As an application, the proposed methods are applied to construct consolidity charts after consolidity analysis on designing controller gains via pole placement technique and consolidity analysis applied on DC motor. Consolidity analysis on designing controller gains via pole placement technique handles three cases of study. This analysis is proposed to be taken into consideration while designing new controllers and in analysis of existing controllers in fuzzy environments. A practical application is also presented through the demonstration of consolidity analysis for the DC motor output position, its controllers, controllability and stability. Finally, consolidity analysis on stability of discrete systems is done with numerical examples of stable systems. This analysis is also applied on isothermal chemical reactor's controller as a practical application.

The summary not more than 500 words