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State Estimation Based on Unscented Kalman Filter for Burgers' Equation

Authors : Takashi Shimizu, Tomoaki Hashimoto

Abstract : Controlling the flow of fluids is a challenging problem that arises in many fields. Burgers’ equation is a fundamental equation for several flow phenomena such as traffic, shock waves, and turbulence. The optimal feedback control method, so-called model predictive control, has been proposed for Burgers’ equation. However, the model predictive control method is inapplicable to systems whose all state variables are not exactly known. In practical point of view, it is unusual that all the state variables of systems are exactly known, because the state variables of systems are measured through output sensors and limited parts of them can be only available. In fact, it is usual that flow velocities of fluid systems cannot be measured for all spatial domains. Hence, any practical feedback controller for fluid systems must incorporate some type of state estimator. To apply the model predictive control to the fluid systems described by Burgers’ equation, it is needed to establish a state estimation method for Burgers’ equation with limited measurable state variables. To this purpose, we apply unscented Kalman filter for estimating the state variables of fluid systems described by Burgers’ equation. The objective of this study is to establish a state estimation method based on unscented Kalman filter for Burgers’ equation. The effectiveness of the proposed method is verified by numerical simulations.

Keywords : observer systems, unscented Kalman filter, nonlinear systems, Burgers' equation
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