

Online Parameter Estimation of the Lankarani-Nikravesh Contact Force Model

Using Two Different Methods

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Abstract

Current contact force models are expected to be used under different environments where the dynamical parameter estimation becomes an important issue especially for complex contact situations. In recent years, a significant amount of research has been carried out in relation to the nonlinear inverse problems, which can be generally divided into two methods: one is the linear one and the other can be called the nonlinear one. In this paper, both methods are presented and compared. The linear method is based on the Taylor series and Exponentially Weighted Recursive Least Squares (EWRLS) estimation method, whereas the core of the nonlinear one is the unscented Kalman filter (UKF) algorithm which need not linearization and can reach the 2nd order (Taylor series expansion) accuracy for any nonlinearity. The Lankarani-Nikravesh (L-N) contact force model is employed to quantify the contact effect since it is proven to be more consistent with the physics of contact. Some simulation examples are employed to evaluate the convergence sensitivity of these two methods to parameter initial conditions. And the comparisons under the same simulation condition between the linear and nonlinear methods indicate that the nonlinear one is more robust and can converge faster than the linear one.

Keywords: Parameter Estimation, Nonlinear Inverse Problem, Linear and Nonlinear Methods, Lankarani-Nikravesh Contact Force Model