Advances in Automobile Engineering

Extended Abstract

Model-Based Control of Synchronizer Shifting Process for Trajectory Tracking Control

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Abstract

A novel approach of the tracking control for synchronizer displacement is introduced in this paper. Based on modeling for the structure of synchronizer and shifting process, a shifting displacement tracking controller is designed by the Udwadia — Kalaba equation. The engagement rule of synchronizer combination sleeve is regarded as the trajectory constraint of the system, certain constraint force is imposed to follow this trajectory constraint, which could be obtained by the Udwadia-Kalaba equation without using Lagrange multiplier or other auxiliary variables. Specific comparative study with conventional PID control is discussed. Simulations and vehicle test results show that the shifting actuator can accurately track the desired trajectory determined by the upper layer control strategy, thus verify the effectiveness of the controller. The classical Lagrangean mechanics is extended to consider servo controls. A mechanical system is subject to a set of constraints. The means to realize the constraints are a set of servo controls, instead of the environment as has been considered in the classical Lagrangean mechanics. We first propose a new Lagrange's form of d'Alembert's principle for the servo case. The servo constraint problem will be solved via the Lagrange's approach. The result is then extended to solve a more complicated servo constraint problem, in which the given force and the constraint force are coupled.

BACKGROUND: Multi-speed transmissions are designed so that the running gears of the individual speeds, even if they are not involved in the power transmission, are constantly engaged. While a gear is fixedly connected to the countershaft, the associated idler wheel can rotate freely on the main shaft. When a specific speed is needed the free wheel has to be fixed to the shaft. At this moment is when the synchronization processes and synchronizers act. They are positioned between two different speeds hence the synchronizer system is double: apart from the idler position they can choose between two gears. Intracranial injury (ICI) from abusive head trauma is the leading cause of death among young abused children but is difficult to detect. Long bone fracture (LBF) may lead to the recognition of abuse in young abused children. OBJECTIVES: This study is the first to report the incidence and features of ICI in children with abuse and LBFs. METHODS: This is a retrospective study of children younger than 3 years with the diagnosis of LBF in the National Trauma Data Bank from 2009 to 2014. LBF, abuse, and clinical features were identified using International Classification of Diseases, Ninth Revision codes. Abuse-related LBF with and without ICI were compared to identify risk factors for ICI. RESULTS: There were 4345 encounters for abuse-related LBF in kids ages < 3 years; 970 (22%) had ICI. Infants < 1 year of age were more likely to have ICI compared with older children (odds ratio [OR] 1.79, 95% confidence interval [CI] 1.38-2.33). After adjusting for age, fracture of the ulna, radius, tibia, or fibula were associated with greater odds of ICI (OR 3.35, 95% CI 2.81-4.00). Abuse-related LBF with additional findings of skull fracture, rib fracture, or head/neck bruising had an increased odds of ICI (OR 8.27, 95% CI 6.85-9.98; OR 2.67, 95% CI 2.28-3.14; OR 2.41, 95% CI 1.99-2.92, respectively).
CONCLUSIONS: ICI occurred in nearly 1 in 4 children under 3 years old with abuse-related LBF. Abuse-related LBF with skull fracture, rib fracture, head/neck bruising, or patient age < 1 year should prompt consideration for ICI with head imaging

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