Advances in Automobile Engineering

Lin, Adv Automob Eng 2015, 4:1
http://dx.doi.org/10.4172/2167-7670.1000112

Opinion

Open Access

Challenges in the Automatic 3D Overhead Cranes Control Design

Tsung-Chih Lin*

Department of Electronic Engineering, Feng-Chia University, Taichung, Taiwan

In recent years, 3D overhead crane have been extensively employed in transport industry for the transfer of heavy loads. In order to increase productivity and improve work efficiency, automatic 3D overhead cranes have gained much attention in factories, warehouses, harbors and other environments where there is the need for moving heavy payloads. However, high-speed operation easily results in the large cargo vibrations and swings which can be dangerous and cause damage. Therefore, a high safety control strategy to fast regulate the x-direction, the y-direction and z-direction of the 3D overhead crane is compulsory.

Up to now, both classical methods and modern approaches have elicited considerable attention. Classical methods include linear and nonlinear control strategies, adaptive control and optimal control technique. For instance, based on a sliding mode surface and Lyapunov stability theorem, sliding mode control (SMC) [1] is a robust control scheme used to deal with the system uncertainties and external disturbances such that the system stability can be guaranteed. On the other hand, modern approaches comprise command shaping techniques, fuzzy logic control (FLC) [2] and neural network design. For example, various adaptive fuzzy control schemes for approximating arbitrary nonlinear functions have been developed to deal with nonlinear systems whose dynamics are poorly understood. Moreover, an adaptive fuzzy sliding mode controller combines the merits of a sliding mode control, a fuzzy inference mechanism and an adaptive algorithm [3].

As we know, the process of sliding mode control is the combination of the approaching phase with and the sliding phase with $s(x, t) \neq 0$ and the sliding phase with $s(x, t)=0$. Unfortunately, the system invariance properties yielding motion which is independent of unmolded dynamics, parameter uncertainties and external disturbances take place only during the sliding phase. During the approaching phase, the tracking performance can be impeded by the parameter uncertainties and disturbances. In order to achieve fast and robust tracking behavior, a time varying sliding surface is proposed [4] by changing the magnitude of the slope and intercept of the surface. Furthermore, a proportional integral (PI)-type switching structure [5] is incorporated into time varying SMC to attenuate the typical chattering of the switching law.

To gather the advantages of the FLC and time varying PI SMC, a novel direct adaptive fuzzy moving sliding mode PI tracking control structure is proposed for a 3D overhead crane system to achieve fast and robust position regulation and anti-swing control [6]. We expect this editorial will provide a study motivation for researchers in both of theoretical investigations and practical applications.

References

1. Utkin VI (1997) Variable structure systems with sliding modes. IEEE Trans Automat Control 22: 212-222.
2. Wang LX (1994) Adaptive Fuzzy Systems and Control: design and stability analysis. Prentice-Hall, New Jersey, USA.
3. Chih Lin T (2010) Based on interval type-2 fuzzy neural network direct Adaptive sliding mode control for SISO nonlinear systems. Communications in Nonlinear Science and Numerical Simulation 15: 4084-4099.
4. Choi SB, Won Park D, Suhada J (1994) A time-varying sliding surface for fast and robust tracking control of second-order uncertain systems. Automatica 30: 899-904.
5. Shahnazi R, Mohammad R, Akbarzadeh T (2008) PI Adaptive Fuzzy Control With Large and Fast Disturbance Rejection for a Class of Uncertain Nonlinear Systems. IEEE Trans. Fuzzy Syztems 16: 187-197.
6. Huang HC (2015) Adaptive fuzzy time-varying sliding mode PI control for uncertain nonlinear time delay systems. Master thesis.

***Corresponding author:** Tsung-Chih Lin, Department of Electronic Engineering, Feng-Chia University, Taichung, Taiwan, E-mail: tclin@fcu.edu.tw

Received January 19, 2015; **Accepted** January 20, 2015; **Published** January 29, 2015

Citation: Lin TC (2015) Challenges in the Automatic 3D Overhead Cranes Control Design. Adv Automob Eng 4: 112. doi:10.4172/2167-7670.1000112