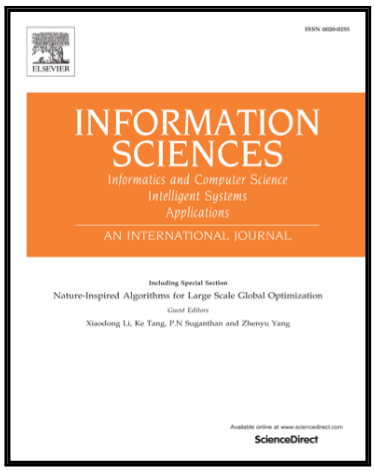

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Abstract In this paper, a dynamic surface control (DSC) based adaptive fuzzy backstepping method is proposed for induction motors with iron losses in electric vehicle drive systems. The DSC is utilized to overcome the "explosion of complexity" problem of classical backstepping, the fuzzy logic systems are used to approximate unknown nonlinear functions and the adaptive backstepping is employed to design controllers. The proposed control method can guarantee all the closed-loop signals are bounded. Simulation comparison results are given to illustrate the effectiveness of the proposed method.

Keywords: Fuzzy Adaptive Control, Backstepping, Dynamic Surface Control, Induction Motor

1 Introduction

Recently, the electric vehicle has been an important branch of the automotive industry because of its great significance to energy security and environmental protection. Induction motors have been increasingly applied in electric vehicles due to their remarkable advantages such as simple structure, high reliability, low cost and high ruggedness. However, since the dynamic model of induction motors is highly nonlinear and multivariable, it is still a hot and difficult task to achieve the excellent control property. The researchers have developed many nonlinear control methods such as sliding mode control [15, 22, 32], input-output linearization control [12], direct torque control [13, 18], backstepping control [10, 8, 26, 25] and so on to achieve high performance control for induction motor drive systems [24, 34]. Nevertheless, the effect of iron losses for the induction motor drive systems have not been considered in the above approaches. When the induction motors are used for electric vehicles working in light load condition for a long time, the system will generate too many iron core losses which affects the whole control performance. Moreover, when the electric vehicle runs in a high speed, the induction motors also cause a large amount of iron losses. Under this circumstance, the above mentioned control methods can't realize the accurate control since they all neglect iron losses.

As one of the most effective approaches to control the systems with parameter uncertainties, particularly for systems with unmatched uncertainties, the backstepping approach has received significant