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A Method to Realize Accurate Dynamic Feedforward Control of a Spray-Painting Robot for Airplane Wings

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Abstract:

The dynamic characteristic has an important effect on the motion precision of a robot and dynamic feedforward control is an effective approach to reduce the effect. However, it is difficult to realize the accurate dynamic feedforward control in an industrial servo system and determine the feedforward coefficients. This paper proposes a method to realize the accurate dynamic feedforward control of a spray-painting robot for airplane wings with large workspace and time-varying dynamics. The basic control method is still the feedback control system with dynamic feedforward compensation, which is the most widely used in industrial field. The control parameters of the closed-loop feedback control system are designed based on atlas method. Considering that only the acceleration and velocity feedforward compensations are provided in an industrial servo system, the mapping relationship between the complete dynamic model and the velocity and acceleration compensators is investigated. Then, the method to realize the accurate feedforward compensation in the industrial servo system is presented based on the complete dynamic model. For a complex robot without an accurate dynamic model, the approach to realize the accurate feedforward compensation is also discussed. The experiment on a physical prototype validates the effect of the proposed methods. This paper is very helpful for the practical control of robots in an industrial field.

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I. Introduction

Surface coatings with good coverage and thickness uniformity directly improve aircraft performance, reliability, and survivability. The surface coating, as the first and the most important defense of aircraft structures, would gradually age or fall off, due to the impact of climate, environment, and complex flow in aircraft flight [1], [2]. If the coating is too thin and weak, the accumulation of a slight point of corrosion may cause the function of aircraft structures to decrease or even fail. However, if the coating is too thick, it increases the unnecessary weight, affecting the airplane performance. In addition, an uneven thickness coating creates additional resistance to

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