Balancing control for single-wheel unicycle Robot using the Sliding mode controller

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Abstract. In recent years, sliding mode control has been disseminated in the industry, including nonlinear control, and is considered as one of the simplest methods for nonlinear system control, including uncertainly model-based systems that are affected by external magnetic interference or parameter conversion. This paper shows the method of sliding mode control for a single-wheel unicycle-like mobile Robot. First, the Robot kinematics model was established by using a self-balancing system based on the balancing control principle in two models; flywheel inverted pendulum. In order to simplify the complicated problem with high nonlinearity, this model was balanced in each direction. Then the system model was emulated, showing the result that the separation sliding mode control worked properly with a large angle of deflection (0.17 rad), and the wheel rolled slowly with the relatively low speed (~2.1 rad/s), while the flywheel rotated slowly with high-speed of rod control (~28 rad/s).

1. Introduction

Along with the development of science and technology, today robots have the ability to replace humans working in hazardous environments, in manufacturing, or serving people for entertainment needs or problems in daily life day… Thanks to the continuous development of technology, robots have been built to serve many different purposes. In particular, the development of automatic balancing systems is also very strong. Over the years it has become a familiar topic in the teaching environment of engineering and automation. More and more products apply the theory of balance for fast, compact movement in short distances.

Balancing of a Two-Wheel Unicycle Robot system is an application developed from the self-balancing reverse pendulum system. For a self-balancing single-wheel unicycle Robot system, it is more complicated, it is a problem of combining the balance of the inverted pendulum and the balance of the handwheel, balancing the unicycle Robot in two directions. This is a complex system with high nonlinearity and instability easily. Issues related to this system including controller design, signal-processing filter design to filter measurement signals... are complex problems in the control field. Currently, there are many products applying the equilibrium principle using various algorithms such as PID, Fuzzy fuzzy logic, LQR... [1-4]. In this paper, a self-balancing single-wheel unicycle Robot system using a sliding controller is presented.

The objective of this paper is to build a simulation model for a self-balancing single-wheel Unicycle-like Robot system using the sliding control technique. The mathematical model of the system is divided