Dynamics of Continuous, Discrete and Impulsive Systems
Series **B:** *Applications & Algorithms* **8 (2001)** 165-177
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MODELLING AND CONTROL OF THE MOTION OF AN AUTONOMOUS BICYCLE : EFFECT OF MOTOR DYNAMICS ON THE DYNAMICAL MODEL

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Abstract. This work deals with the modelling and control of the motion of an autonomous bicycle. It is assumed here that the bicycle is controlled by a pedalling torque, a directional torque and by a rotor mounted on the crossbar that generates a tilting torque. The pedalling torque and the directional torque are, each of them, generated by a dc-motor. In addition, the rotor's motion is driven by a third dc-motor. The aim of this work is first to obtain a set of dynamic equations of the bicycle's motion that include the motors dynamics. Then, two inverse dynamics transformations are applied successively, under which the kinematcs of the system is separated from the dynamics, thus enabling one to use linear control for the design of stabilization and guidance laws for steering the motion of the bicycle.

Key Words: Autonomous bicycle, rotor, motor dynamics, stabilization, guidance.
AMS (MOS) subject classification: 93B05, 70E15, 70Q05, 93C15

1 INTRODUCTION

This work deals with the modelling and control of the motion of a riderless bicycle (see Fig.1). It is assumed here that the bicycle is controlled by a pedalling torque, applied on the rear wheel; a directional torque, applied on the axis going through the points 3 and 2 (see Fig.1); and by a rotor mounted on the crossbar that generates a tilting torque. Each of the above-mentioned torques is generated by a dc-motor.
The stabilization and guidance of the motion of an autonomous bicycle on a horizontal plane is dealt with in [1]. There it is assumed, that the motion of the bicycle is controlled, in an identical configuration as here, by a pedalling torque,applied on the rear wheel; a directional torque and by a rotor mounted on the crossbar that generates a tilting torque. Furtheremore, in [1], the three applied torques serve as the control variables. This work explores the possibility of controlling the motion of the riderless bicycle by applying the same torques as described above, but where the control variables here are

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