

MODELING & CONTROL OF 5 DOF TWO WHEELED ROBOTIC MACHINE FOR INDUSTRIAL APPLICATION

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Abstract

Two wheeled balancing robots are an area of research that may well provide the future locomotion for everyday robots. The unique stability control that is required to keep the robot upright differentiates it from other types of robotics machines. The mathematical modeling of the naturally unstable system two wheeled robotics machine principle is provided by the inverted pendulum principle. This is then utilized to develop and implement a suitable stability control system that is responsive, timely and successful in achieving this objective. Adding more degrees of freedom to the two wheeled robots will add challenges to develop a robust controller that will maintain the stability of the system against different degrees of motions and carrying additional loads. The robot will add new degree of freedom represented by the horizontal motion of the linear actuator which will handle the end effector.

The design of two wheeled robot with five degrees of freedom perform a high challenge for the control, therefore the modeling and design of such robot should be precise with a uniform distribution of mass over the robot and the actuators. Moreover, to build such robotics machine suitable for Industrial application and able to carry additional loads without affecting its stability, different controllers applied to get the best performance.

PID controller and Fuzzy Logic Controller are applied on the system in order to stabilize the system and compare their robustness to get the most efficient controller for the system. Also, these controllers are examined with different trajectory of movements and against different disturbance forces.

The PID controller optimized by Bacteria Forging optimization method to get the best values of controller gains that will provide the best stability for the system with minimum overshoot, rise time and settling Time. The three controller's performance compared together for a real path with load mass added during the examinations.

The project is concluded with comments on each aspect of the project with recommendations for improvement, additional capabilities and future areas of investigation in engineering.