BIOGRAPHICAL SKETCH

Sumit Yadav was born and raised in state Haryana, India. He received his undergraduate degree from Swami Devi Dayal Institute of Engineering and Technology, Kurukshetra University. Currently he is pursuing his masters from Tennessee Technological University in Electrical and Computer Engineering and he is also president of Graduate Electrical and Computer Student Association (GECESA). Previously he has worked for Relio Quick Ind. Pvt. Ltd as an operation executive and as a supply chain executive in Amtek Auto Ltd. His interests are robotics, controls, artificial intelligence, business, marketing, and astronomy.

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College of Engineering
TENNESSEE TECH

College of Engineering
TENNESSEE TECH

The Department of

Electrical & Computer Engineering

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Of

Sumit Yadav

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FIELD OF STUDY

ROBOTICS AND CONTROL SYSTEM

THESIS TOPIC

"ADAPTIVE CONTROL OF NONLINEAR DYNAMIC ROBOTIC SYSTEMS"

EXAMINING COMMITTEE

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ABSTRACT

In this thesis, adaptive controllers are designed for an inverted pendulum and a quad-rotor. Adaptive control is extensively used in the field of robotics, because of the non-linear characteristics, highly coupled equations and parametric uncertainties and disturbances. This makes adaptive controller the right choice for such systems.

Inverted pendulums have been extensively used to study the control performance of many engineering control problems. An adaptive control strategy is proposed for the inverted pendulum motion and posture control problem. Adaptive control also take care of non-linear friction. The control strategy use the Lyapunov stability-based online adaptation technique that gives the good asymptotic motion tracking and posture control. Results for various situations highlight the achievement of the proposed scheme in compensation for external disturbance and friction.

Unmanned Aerial Vehicles have received lot of attention in last decade. They can be programmed to do predefined task without any human intervention. The control of such machines is not a trivial task. The dynamics are non-linear and highly coupled with each other. Some of the machine are under-actuated with less number of control inputs then degree of freedom. The control became harder under disturbances and parametric uncertainties. This thesis seeks to address this issue by suggesting an adaptive control under parametric uncertainties. The adaptive control scheme learns the quad-rotors inverse model with a Lyapunov-based adaption law. For that, a robustness feedback loop is used to stabilize the quad-rotor at start-up. Therefore, the controller achieves accurate motion tracking with parametric uncertainties. Unlike many controllers, the proposed adaptive control scheme's stability is guaranteed by Lyapunov direct method. The proposed controller's performance in coping with parameter variations is highlighted in different operating conditions.