CONTROL AND DESIGN OF ROTATION INVERTED PENDULUM SYSTEM

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ABSTRACT

INVERTED PENDULUM SYSTEMS ARE NONLINEAR AND UNSTABLE SYSTEMS. THEY ARE USUALLY USED TO VERIFY THE EFFECTIVENESS OF THE PROPOSED CONTROL SCHEMES. THIS PAPER PROPOSES TWO CONTROLLERS IN THE INVERTED PENDULUM SYSTEM. FIRST ONE IS TO LINEARIZE THIS NON-LINEAR SYSTEM AND USES THE LINEAR THEORY TO DESIGN A STATUS FEEDBACK CONTROLLER. SECOND ONE PROPOSES A DESIGN METHOD OF FUZZY LOGIC CONTROLLER WITH ROBUST CONTROL FEATURE. A STEADY REFERENCE MODEL WAS DESIGNED FIRST. THE INPUT OF THIS MODEL WAS THE ANGLE OF SWINGING ARM AND THE OUTPUT WAS THE FOLLOWING ANGLE OF THE INVERTED PENDULUM. ONE FUZZY SYSTEM WAS USED TO SIMULATE THE NON-LINEAR DYNAMIC PART OF THIS PENDULUM SYSTEM. THE FUZZY LOGIC CONTROLLER WITH ROBUST CONTROL FEATURE DEVELOPED FROM THIS FUZZY SYSTEM WAS USED TO FORCE THE ANGLE OF INVERTED PENDULUM TO BE COINCIDED WITH THE OUTPUT OF THE REFERENCE MODEL. WHEN THE ERROR OF THESE TWO BECAME NEAR ZERO, THE INVERTED PENDULUM BECAME INVERTED ON THE VERTICAL POSITION AND THE ANGLE OF SWINGING ARM WAS CLOSE TO THE ORIGINAL ZERO POSITION. ACCORDING TO THE ROBUST STEADY DESIGN TECHNIQUE, THE ERROR EMERGED IN THE FUZZY SIMULATION PROCESS CAN BE COMPENSATED. THE BAD EFFECT RESULTING FROM THIS ERROR CAN BE SUPPRESSED WITHIN ANY INTENDED RANGES. FURTHERMORE, A REAL SWINGING TYPE INVERTED PENDULUM SYSTEM WAS SIMULATED IN ORDER TO VERIFY THE EFFECTIVENESS OF THE METHOD PROPOSED IN THIS PAPER.

Keywords : Inverted Pendulum System, Fuzzy Logic Controller, Robust Control.

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