

Desain pengendali kestabilan sistem inverted pendulum menggunakan kendali LQR = Stability control design for inverted pendulum system using LQR

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Abstrak

Tema Inverted pendulum banyak diteliti oleh peneliti dunia, salah satu temanya adalah pemodelan dan perancangan pengendali. Tema inilah yang diambil sebagai tema penelitian dalam tesis ini. Dalam tesis ini dimodelkan tiga jenis inverted pendulum yaitu Single Inverted Pendulum, Double Inverted Pendulum, dan Dual Inverted Pendulum. Model matematik dari ketiga jenis inverted pendulum ini diturunkan dari persamaan Euler- Lagrange. Model matematik yang didapatkan disimulasikan menggunakan matlab simulink. Dari hasil simulasi didapatkan bahwa ketiga jenis inverted pendulum ini tidak stabil namun demikian ketiga jenis inverted pendulum ini dapat dikendalikan sehingga ketiga jenis inverted pendulum ini dapat distabilkan. Untuk menstabilkan sistem inverted pendulum digunakan pengendali LQR. Dari hasil simulasi terlihat bahwa sistem inverted pendulum dapat distabilkan, namun kestabilan sistem hanya dapat dipenuhi dalam batasan nilai variabel keadaan yang tertentu.

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Inverted pendulum is widely studied by researchers around the world. One of its research themes is modeling and control design. This theme also becomes the research focus of this thesis. In the research, three types of inverted pendulum have been studied. That are Single Inverted Pendulum, Double Inverted Pendulum and Dual Inverted Pendulum. Mathematical models of these inverted pendulums are derived from the Euler-Lagrange equation. Based on these models, simulation is carried out by using Matlab/Simulink. Simulation results showed that the inverted pendulums are not stable but controllable. Therefore the inverted pendulums can be stabilized. In this research, LQR controller is used to stabilize the inverted pendulum systems. Simulation results show that the inverted pendulum systems could be stabilized only within limited range of the state variable values.