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Robustness analysis of fractional order PID for an electrical aerial platform (Article)

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Abstract

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This work was performed to objectively measure and assess the robustness and tracking performance of fractional order of proportional, integral and derivative (FOPID) controller as compared to the conventional PID control. In satellite research and development, the satellite undergoes numerous tests such as thermal, acoustic and vibration tests in the cleanroom environment. However, due to space limitation in the cleanroom and the sensitive components of the satellite, it requires vibration-free, smooth and precise motion when handling the satellite. In addition, measurement interference might occur due to cable routing during procedures or tasks performed by an operator. Unlike the previous work, the robustness analysis of FOPID controller was not systematically conducted. In this paper, the analysis took into account the actuator dynamics, and various tests were considered to measure the robustness of FOPID controller. The designed FOPID controller was implemented on the scissor-type lifting mechanism of motorized adjustable vertical platform (MAVeP) model, and its performance was compared with the traditional PID controller. A comprehensive verification using MATLAB and Solidworks was carried out to generate the model and conduct the analysis. Both controllers were initially tuned using Nichol-Ziegler technique, and the additional FOPID controller parameters was tuned using the Astrom-Hagglund method. From the simulation work, it was found that the FOPID controller's tracking error was reduced between 10% - 50% for the disturbance rejection tests and reference to disturbance ratio (RDR) spectrum was higher as compared to PID. The analysis in this paper was predicted to be the main driver to implement FOPID controller in the complex system in the industry, especially for sensitive material handling and transportation such as satellite. © 2018, The Korean Society of Mechanical Engineers and Springer-Verlag GmbH Germany, part of Springer Nature.

SciVal Topic Prominence

Topic: Controllers | Control | proportional integral

Prominence percentile: 97.712

Author keywords

- Astrom-Hagglund and FOPID control
- MAVeP
- Reference to disturbance ratio
- Robust control
- Satellite facilities
- Scissor mechanism
- Ziegler-Nichols

Indexed keywords

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- Ziegler Nichols

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