東京大学
THE UNIVERSITY OF TOKYO

**Department of Aeronautics and Astronautics**
**School of Engineering**
Hongo 7-3-1, Bunkyo-ku, Tokyo, 113-8656, JAPAN

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To whom it may concern,

*Review of Mr. Alisher Aden's Ph.D. Dissertation*
*Thesis: Development of a parameter synthesis method for a nonlinear satellite attitude control system based on its mathematical model in linear form.*

The dissertation addresses parameter synthesis for a nonlinear satellite attitude control system with reaction wheels. For small spacecraft and nanosatellites, mass, power, and actuator limits are tight, which makes it difficult to find acceptable feedback gains, and if we hire the method of iterative tuning of the gains, it will require very long time to find acceptable gains.

The proposed method tries to transform the original nonlinear model of attitude dynamics into linear form to analytically derive the optimal and acceptable control system design. Unlike a local linearization around an operating point, the proposed scheme preserves the structure of the actual equations of motion. It makes linear control theory tools applicable without discarding the nonlinear dynamics.

The key technical contribution of the dissertation is the transition to a normalized characteristic equation. This separates the synthesis into two steps: first, specify the shape of the transient response in relative time; second, set the time scale for the physical system. PD control-law parameters then follow analytically, rather than through numerical iterations in trial and error fashion.

Actuator constraints can be treated as part of the synthesis procedure by utilizing the proposed transformation. In many cases, controller parameters that satisfy stability conditions may violate real world limitation such as reaction-wheel torque or angular velocity limits. The author connects spacecraft inertia, desired transient response, settling time, and reaction-wheel capacity into a single calculation that flags infeasible requirements before hardware is involved.

The proposed method is tested on two objects: a model microsatellite and an experimental attitude-control prototype. Verification uses MATLAB/Simulink and Simscape Multibody. Results for both cases are consistent with the theoretical predictions.

The problem is clearly scoped, the analytical treatment is coherent, and the verification covers more than one configuration. The work has been published in international journals and conference proceedings.

From these observations, I would like to recommend Mr. Alisher Aden's dissertation for defense for the degree of Doctor of Philosophy.

Shinichi Nakasuka, Project Researcher, Ph.D
Department of Aeronautics and Astronautics
School of Engineering, The University of Tokyo
Hongo 7-3-1, Bunkyo-ku, Tokyo, 113-8656, Japan
Tel.: +81-3-5841-6590　nakasuka@space.t.u-tokyo.ac.jp