Introduction to Space Systems Dynamics Laboratory

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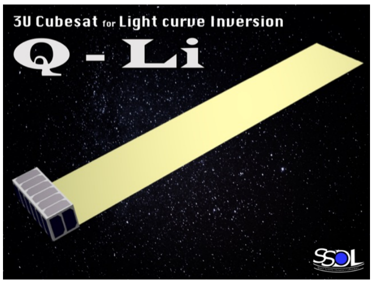
During the past decades, outer space activities have had a dramatic influence on human life and culture by

- increasing our scientific knowledge of the solar system and the universe,
- revolutionizing communication and imaging systems, and
- providing the technical foundations to human existence and the utilization of resources in space.

These capabilities and activities have been made possible by the development and application of engineering expertise. At present, the engineering community is called upon to further enhance the existing technologies in order to develop reliable and high-performance space capabilities that are less demanding in cost.

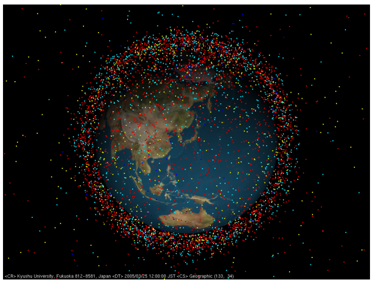
The missions of the Space Systems Dynamics Laboratory (SSDL) are education and research of space engineering with focus on astrodynamics and satellite system design. Additional topics of research are the investigation of the orbital environment with particular interest to space debris.

1. Small Satellite Design



SSDL performs unique “hands-on” satellite design activities through the design and construction of Q-Li, the 3-Unit CubeSat for Light Curve Inversion Demonstration, which aims at establishing a mathematical technique to model the surfaces of rotating objects from their brightness variations. Q-Li is also planning to perform in-situ measurements of tiny space debris, which would lead to a better understanding of the current space environment. This project involves mission analysis, spacecraft system design as well as subsystem design problems. Now, we are conducting the feasibility study.

2. Space Debris Modeling



To address the space debris issues which threaten safety in space, space debris evolutionary models have been built by incorporation of laws of astrodynamics and empirical assumptions. The assumptions have been augmented and verified by a series of laboratory satellite impact tests. This work not only contributes to the world-wide effort to predict the future space debris population, but it also provides a novel tool to identify effective procedures of space debris mitigation and environmental remediation.

3. Space Situational Awareness

SSDL also applies the space debris modeling for Space Situational Awareness to devise an effective and practical search strategy applicable for breakup fragments around the Earth. The space debris modeling can characterize, track, and predict the behavior of groups of breakup fragments. Such analyses can specify where and how we should conduct ground-based optical measurements of breakup fragments around the Earth, and how we should process successive images to detect dimmer objects moving in a field-of-view. The analyses can also identify the origin of breakup fragments detected.