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MIRZO ULUGBEK: ENGINEERING MODEL VERIFICATION AND DEVELOPMENT OF UZBEKISTAN'S FIRST 6U CUBESAT FOR EARTH OBSERVATION

Abstract

Uzbekistan's first scientific and technological satellite, Mirzo Ulugbek, is a 6U CubeSat developed under a bilateral partnership between the Kyushu Institute of Technology (Kyutech) and the Space Research and Technology Agency (Uzcosmos). This paper reports on the project's progression from preliminary design toward flight readiness, with emphasis on the Engineering Model (EM) environmental test campaign, a domestically developed propulsion subsystem currently under integration, and the capacity-building program supporting the mission.

The satellite's bus architecture builds upon the flight heritage of Kyutech's LaSEINE laboratory, most notably the 6U KITSUNE Earth observation satellite, which provides a baseline reference for the structure and Electrical Power System (EPS). The On-Board Computer (OBC), inherited from the BIRDS-X and VERTECS 6U satellite projects, provides direct interfaces to the UHF and S-band transceivers.

The Attitude and Orbit Control System (AOCS) combines magnetorquer actuation, validated on the CURTIS and LEOPARD missions, with reaction wheel technology soon to be evaluated in-orbit aboard BIRDS-RPM, together meeting the pointing accuracy demanded by the primary optical payload. Orbital maneuver capability will be provided by a resistojet thruster developed domestically within Uzbekistan, marking a key contribution from the country's emerging space industry.

The primary payload is a high-resolution optical imager designed to achieve a Ground Sampling Distance (GSD) of approximately 5 meters from a Sun-Synchronous Orbit (SSO). The payload is connected to the bus through an SoC/FPGA-based controller board, which also interfaces with a high-speed X-band transceiver, supporting the mission's data budget requirements.

This paper reports on the Engineering Model environmental test campaign, planned to start in July 2026, encompassing vibration, shock, thermal-vacuum, and functional verification tests. The expected

outcomes and their role in validating key design decisions ahead of the Flight Model build will be discussed, alongside any issues identified before Critical Design Review.

The development team comprises 22 graduate students, with seven Uzbek engineers at its center leading design, assembly, and test activities under the supervision of 14 Kyutech staff. This capacity-building model ensures that the Uzbek engineers will be equipped to independently lead national satellite programs upon their return. With launch planned for late 2027 aboard a SpaceX rideshare mission, Mirzo Ulugbek represents a foundational milestone in Uzbekistan's development as an independent spacefaring nation.