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Author: Mr. Jooyong Yang
Seoul National University, Korea, Republic of

Ms. Yumin Jeong
Seoul National University, Korea, Republic of
Mr. Hyunwoo Jun
Seoul National University, Korea, Republic of
Mr. Dohyun Nam
Seoul National University, Korea, Republic of
Mr. Sunho Park
Seoul National University, Korea, Republic of
Mr. Hogun Park
Seoul National University, Korea, Republic of
Mr. Dongmin Shin
Seoul National University, Korea, Republic of
Mr. Jiwan Seo
Seoul National University, Korea, Republic of
Mr. Jonghwan Yoon
Seoul National University, Korea, Republic of
Mr. Minhyung Kim
Seoul National University, Korea, Republic of

TRACY: SOUNDING ROCKET TELEMETRY SYSTEM WITH IMPROVED STABILITY THROUGH AUTOMATIC CONTROL OF DIRECTIONAL ANTENNA

Abstract

Real-time telemetry of a sounding rocket's flight status serves to ensure redundancy of the flight data repository in case the on-flight memory device is destroyed, as well as to mitigate the risk of accidents in the range by alerting the nearby personnel of an oncoming ballistic object.

While a high-gain directional antenna is preferable over an omnidirectional antenna for the ground station receiver given the power constraint of the on-board telemetry module, manual control of the antenna direction can lead to connection instability, especially during the initial propelled flight stage with high velocity and acceleration.

TRACY (stands for Tracker with Automatically Controlled Yagi antenna) is a telemetry system with improved stability through automated tracking of the rocket by a directional antenna. Its development was motivated by a previous instance where the low resolution of the telemetry data due to frequent losses of connection during the propelled flight, combined with the total destruction of the avionics system after a ballistic descent, posed challenges to analysing the aerodynamic behaviour of the rocket and assessing the flight events that led to the uncontrolled descent.

The system comprises an on-board sensor/transmitter system, based on commercially available sensors and telemetry modules, and a ground station, which makes an accurate estimation of the rocket's position based on the IMU and GPS data provided by the transmitter along with the camera tracking results. The

antenna direction is adjusted based on this estimate, with delays of various sources (e.g. motor response) taken into account.

The development of TRACY was led by three undergraduate students as a part of KHAOS, HANARO's K-class sounding rocket building project. HANARO is an undergraduate rocket science club at Seoul National University with members of various academic backgrounds. KHAOS aims to be a low-cost, easily reproducible rocket that can serve as a versatile test bench for various experiments, including sensor system validation for higher-class rockets and atmospheric observations.