

## ROSgeoregistration: Aerial Multi-Spectral Image Simulator for the Robot Operating System

**Authors :** Andrew R. Willis, Kevin Brink, Kathleen Dipple

**Abstract :** This article describes a software package called ROS-georegistration intended for use with the robot operating system (ROS) and the Gazebo 3D simulation environment. ROSgeoregistration provides tools for the simulation, test, and deployment of aerial georegistration algorithms and is available at [github.com/uncc-visionlab/rosgeoregistration](https://github.com/uncc-visionlab/rosgeoregistration). A model creation package is provided which downloads multi-spectral images from the Google Earth Engine database and, if necessary, incorporates these images into a single, possibly very large, reference image. Additionally a Gazebo plugin which uses the real-time sensor pose and image formation model to generate simulated imagery using the specified reference image is provided along with related plugins for UAV relevant data. The novelty of this work is threefold: (1) this is the first system to link the massive multi-spectral imaging database of Google's Earth Engine to the Gazebo simulator, (2) this is the first example of a system that can simulate geospatially and radiometrically accurate imagery from multiple sensor views of the same terrain region, and (3) integration with other UAS tools creates a new holistic UAS simulation environment to support UAS system and subsystem development where real-world testing would generally be prohibitive. Sensed imagery and ground truth registration information is published to client applications which can receive imagery synchronously with telemetry from other payload sensors, e.g., IMU, GPS/GNSS, barometer, and windspeed sensor data. To highlight functionality, we demonstrate ROSgeoregistration for simulating Electro-Optical (EO) and Synthetic Aperture Radar (SAR) image sensors and an example use case for developing and evaluating image-based UAS position feedback, i.e., pose for image-based Guidance Navigation and Control (GNC) applications.

**Keywords :** EO-to-EO, EO-to-SAR, flight simulation, georegistration, image generation, robot operating system, vision-based navigation

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