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Assessment of Multispectral Imaging System for UAS Navigation in a GPS-denied Environment

Yakimenko, Oleg A.

Monterey, California: Naval Postgraduate School

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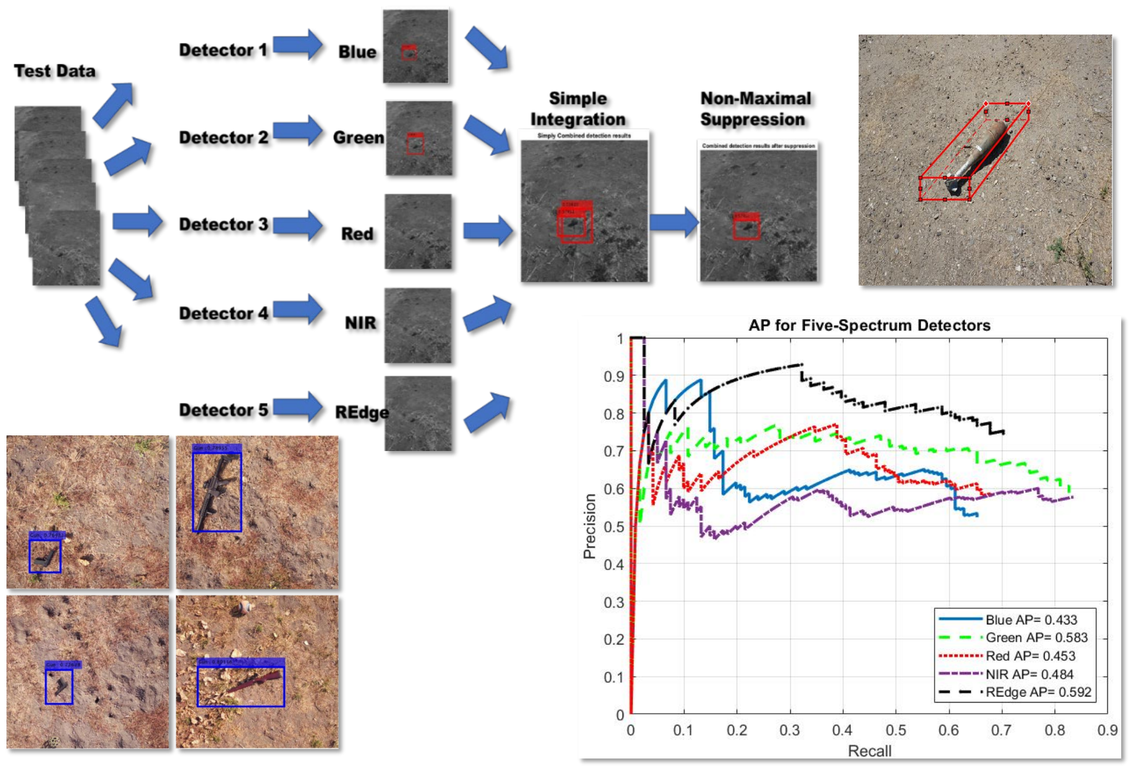
Background and Motivation

- These days, an integrated EO/IR sensor and its associated signal or image processing is a standard payload for manned and unmanned aerial systems (UAS).
- Whether using multispectral (MS) imagery, a relatively new technology, has any benefits compared to a standard integrated EO/IR sensor?
- This includes enhancing accuracy and precision of object detection, classification and tracking (DCT) and additional/alternative aid to navigation (ATON) in the GPS-degraded or GPS-denied environments.

Unexploded ordinances (UXOs) / mines detection (DCT task)



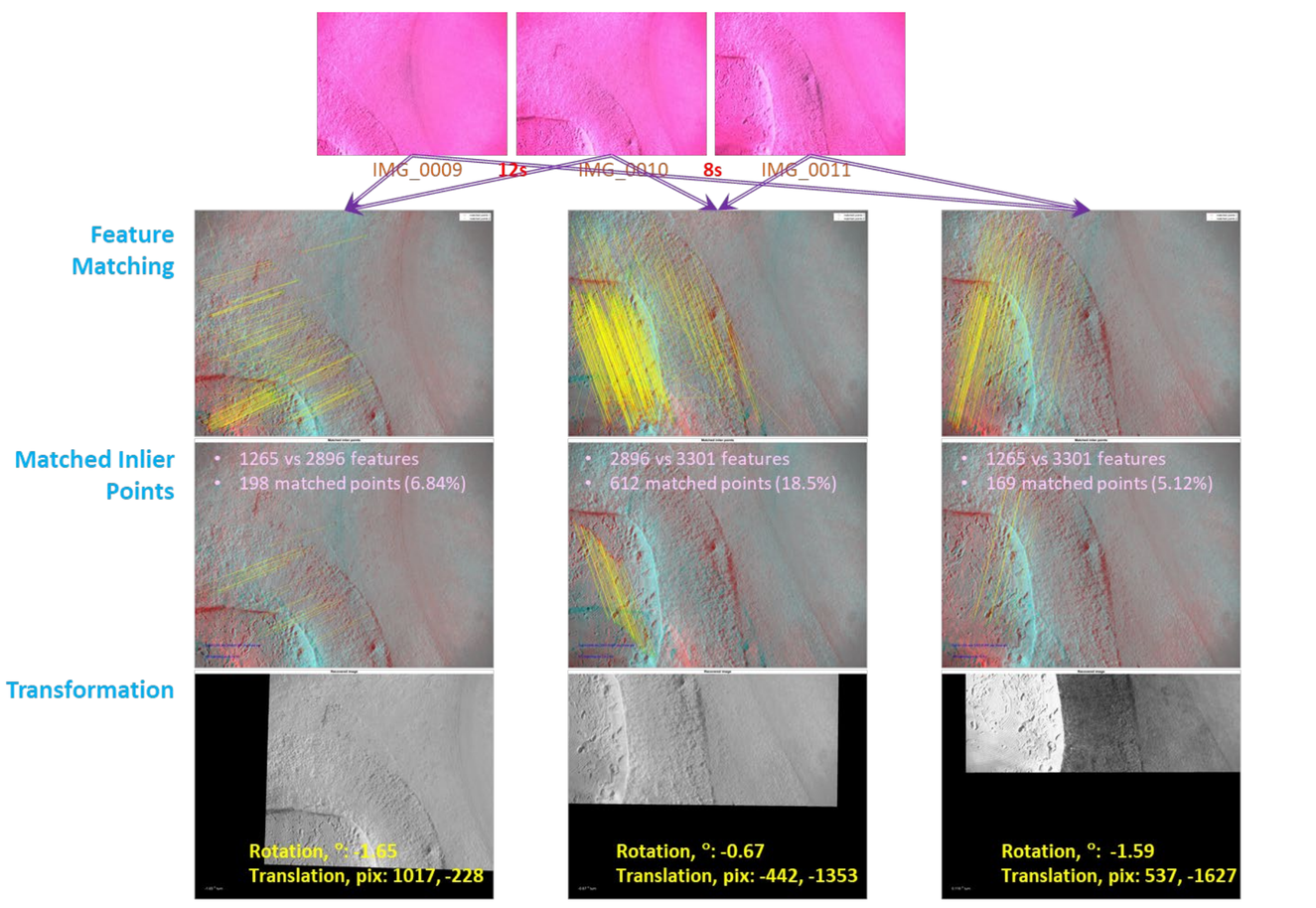
MS-based DCT examples

MS-based Detection of UXOs

- Using MS vs traditional EO/IR imagery complimented with artificial intelligence (AI) methods has a clear benefit. MS imaging captures information that cannot be seen with the human eye and presents a more data-rich mosaic for applications within the remote-sensing.
- While DCT precision for each individual spectral band is lower than that of EO sensor, the detection outputs compliment each other.
- As a result, the integrated detector composed of pre-trained convolutional neural networks for each band happens to be a more reliable and precise DCT tool.

MS-based Odometry

- If the two consecutive images represent about the same scene [even though they are far apart from each other (slow flight, high-altitude flight, high sampling rate)], they share a significant number of matching features.
- Applying the most efficient computer-vision (CV) feature-finding algorithms for each spectral band of MS sensor increases a pool of complementary matching features from which a more accurate geometric transformation could be derived.
- The efficiency of the developed algorithms allows running them in real time on a secondary single-board computer aboard a small UAS.



Visual odometry based on the MS feature matching

Results and Recommendations for Future Work

- Utilizing a small UAS equipped with a MS sensor and CV/AI algorithms may be very beneficial to DoD and DoN enhancing existing and offering new capabilities related to both DCT and ATON.
- Future work includes tuning algorithms and studying effects of operating environment, terrain, altitudes, object size and material, time of the day, weather, number of spectral bands, and resolution.

Researcher: Prof. Oleg Yakimenko
Graduate School of Engineering and Applied Sciences

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