

Multi-Vehicle Systems for Collecting Shadow-Free Imagery in Precision Agriculture

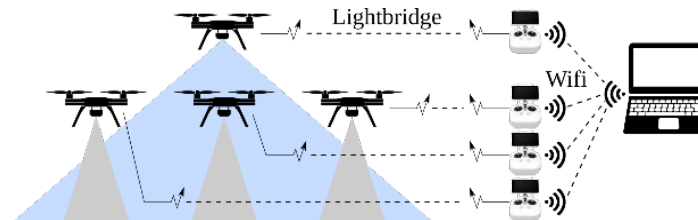
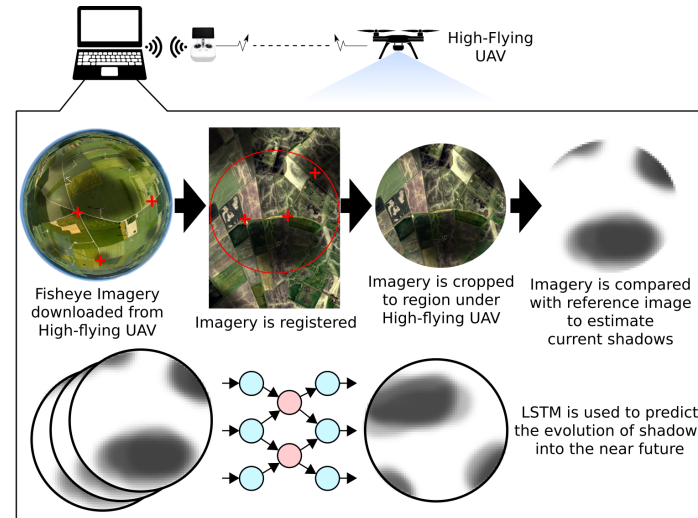
NRI: FND: COLLAB: Multi-Vehicle Systems for Collecting Shadow-Free Imagery in Precision Agriculture/2020-67021-30756/April 1, 2020/Boris Murmann, Stanford University; Bryan Poling, Sentek Systems; Claire J. Tomlin, UC Berkeley; Dušan M. Stipanović, UIUC

Challenge

- Aerial imaging with multi-spectral cameras is widely used to detect crop nutrient deficiencies and other crop problems in precision agriculture
- Clouds cast shadows on the ground, confusing interpretation of multi-spectral remote sensing data
- Multi-objective control of multiple vehicles based on neural network predictions

Solution

- Detect cloud shadows on ground using downward-looking fisheye imagery from a high-flying drone
- Predict the evolution of shadows into the future using LSTM NNs
- Novel closed-form control laws for a team of drones to collaboratively image area, avoiding shadows, to enable shadow-free reconstruction and stitching
- Stability and performance guarantees for neural networks used in time-varying prediction algorithms



More information is available at:

<https://publish.illinois.edu/mvscsfipa/>

Scientific Impact

- Formal characterizations of the typical behaviors of neural networks and dynamical systems used in machine learning algorithms
- New multi-objective and multi-agent control design in closed-forms that are easy and efficient to implement

Broader Impact

- Triple the amount of usable multi-spectral drone imagery that can be collected by farmers and agronomists in a season by enabling data collection in a broader range of weather conditions
- Promote broader adoption of remote-sensing-based crop nutrient management solutions, thereby reducing excess nutrients left in the environment and reducing fertilization costs for farmers
- Development of new educational materials in robotics and control with strong emphases on applications of robotics in precision agriculture
- New module for UCB Girls in Engineering summer program for middle school girls and contributions to Women in Engineering at Illinois programs and Engineering Open House at UIUC