Tutorial-T2 (Full Day)

EMERGING sUAS TECHNOLOGY FOR PRECISION AGRICULTURE APPLICATIONS (AGDRONETECH17)

Organizers

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Tutorial Summary

There has been a rapidly increasing interest in small unmanned aerial vehicles (sUAVs). With the emergence of high power density batteries, long range and low power micro radio devices, cheap airframes, and powerful microprocessors and motors, small/micro UAVs have become applicable in civilian/ public domain applications such as remote sensing, mapping, traffic monitoring, search and rescue. Many applications and research projects could greatly benefit from having remote sensing (RS) data with high temporal and spatial resolution. However, most of the available RS data is expensive, has low spatial resolution and single feature, is sampled at a low frequency, and/or has a long turnover time.

This tutorial focuses on emerging sUAS technology for precision agriculture applications. According to http://www.precisionag.com/article/35499/precision-ag-2013-top-5-technologies-to-watch drones are, for the first time, listed in the top five technologies to watch in precision agriculture. According to http://www.auvsi.org/econreport, 90% of the potential market for UAVs will be accounted for by public safety and precision agriculture. UAVs will inject $82 billion in economic activity and generate up to 100,000 new jobs between 2015 and 2025. Therefore, it is timely to review emerging sUAS techniques in precision agriculture applications. The fundamental task is how to use sUAS for early detection of crop stresses due to various factors such as water / drought, salinity, nitrogen, pest(s), heat, frost, and mineral(s) in soil. We will also discuss using UAVs in precision application of agro-chemical such as pesticides, growth regulators and etc. We will cover benefits and future potentials of using UAVs in real citrus production by the University of Florida Citrus Research and Education Center (CREC).

This tutorial is the natural outgrowth of the organizers work and it will include topics and information related to: i.) Multi-UAV based remote sensing platform that was developed to achieve multi-spectrum images with high temporal and spatial resolution including the concept of personal remote sensing; ii.) Development of Thermal Infrared (TIR) personal remote sensing (PRS) technologies with low cost sUAVs used to demonstrate how one can perform UAV-based scientific thermal measurements; iii.) Developing the complete AggieAir sUAS system, including architecture designs, airworthiness, ground segments (Ground Control Stations as well as safety pilot interfaces), and human factors (crew training and field operations); iv) Discussion of emerging sUAS technology for precision agriculture

applications.

Precision agriculture is ranked among the top five UAV applications (released reports in 2014, 2015) and remains a challenging area as it is a big data industry and more and more realize this mega-trend. As such, emphasis will be given to "Drone Data" based on "Scientific Data Drones" (SDD), explaining in detail recent discoveries in a new type of data analytics centering on phenotyping and ground truthing. Crop spectral sensitivity under various UAV imaging conditions will be re-examined.

It is to be noted that as more and more exemptions are being awarded by the FAA to various commercial entities, AgDroneTech continues with presentations on new results obtained in the past year with an emphasis on real field tests and ground truthing efforts.

Tutorial outline

1. Review of UAV-based Personal Remote Sensing (PRS, or Data Drones)
2. Small UAS (sUAS) as "Scientific Data Drone" for Precision Ag: From Data to Decision to Action to Data
3. UAV applications in precision agricultural phenotyping: benefits and the future potential
4. Optimal crop spectral response sensitivity study for sUAS and applications
5. Application challenges and solutions (examples and participant mind storming session)

Intended audience

- Graduate students in electrical engineering, mechanical and aerospace engineering, agriculture engineering, and intelligent mechatronics;
- Small unmanned aerial vehicle system engineers;
- Natural resource managers, water engineering professionals;
- Farmers, growers and precision agriculturists;
- UAV practitioners, researchers and developers.

Tutorial Material: *To be delivered to participants via Dropbox invitation and USB jump drive swap.*

Tutorial References:

1. White paper (free access): **"***AggieAir: Towards Low-cost Cooperative Multispectral Remote Sensing Using Small Unmanned Aircraft Systems*," Haiyang Chao, Austin Jensen, Yiding Han, YangQuan Chen, and Mac McKee, Advances in Geoscience and Remote Sensing, Gary Jedlovec, Ed., Vukovar, Croatia. ISBN: 978-953-307-005-6, IN-TECH, pp. 463-490, 2009.
2. Link: http://www.intechopen.com/articles/show/title/aggieair-towards-low-cost-cooperative-multispectral-remote-sensing-using-small-unmanned-aircraft-sys
3. Mishra, A. R., D. Karimi, R. Ehsani, and W.S. Lee. 2012. *Identification of citrus greening (HLB) using a VIS-NIR spectroscopy technique*. Transactions of the ASABE, 55 (2): 711-720. http://swfrec.ifas.ufl.edu/hlb/database/pdf/6_IdentificationCitrusGreening_12.pdf
4. Garcia-Ruiz, F., S. Sankaran, J. M. Maja, W. S. Lee, W. S., J. Rasmussen, R. Ehsani. *Comparison of two aerial imaging platforms for identification of Huanglongbing infected citrus trees*. Computers and Electronics in Agriculture, DOI: http://dx.doi.org/10.1016/j.compag.2012.12.002
5. Coopmans, C., Stark, B., Jensen, A., Chen, Y., Mckee, M. (2013). *Cyber-Physical Systems Enabled by Small Unmanned Aerial Vehicles*, in K. P. Valavanis & G. J. Vachtsevanos (Eds.), Handbook of Unmanned Aerial Vehicles, Springer, 2015.
6. Stark, B., Coopmans, C., & Chen, Y. *Concept of Operations of Small Unmanned Aerial Systems: Basis for Airworthiness towards Personal Remote Sensing*, in K. P. Valavanis & G. J. Vachtsevanos (Eds.), Handbook of Unmanned Aerial Vehicles. Springer, 2015.