Mahyar Aboutalebi UWRL Outstanding Student Spotlight | Utah Water Research Laboratory

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Each month, the UWRL takes the opportunity to recognize a student, alumni, or staff member who displays extraordinary passion dedication and leadership.

For our first Student Spotlight of 2019, we feature Mahyar Aboutalebi, a PhD student in Civil and Environmental Engineering at USU and the UWRL. Mahyar was chosen because he continually goes above and beyond the expectations of UWRL faculty and staff. As a member of the UWRL’s AggieAir UAV Program, Mahyar helps to develop and deploy new modeling capabilities for use in remote sensing research and resource management applications. Mahyar’s research focuses on remote sensing evapotranspiration models, and incorporating the information from AggieAir UAV imagery into a high resolution energy balance model to improve the accuracy of evapotranspiration estimates in complex agricultural environments.

Since graduating with his Master of Science degree in Water Resources Engineering from the University of Tehran, Mahyar has been presented with 4 awards for his research and contributions from various organizations:

- Best Reviewer Award, 2018 “Remote Sensing Journal” (MDPI)
- Runner-up ‘Autonomous Air and Ground Sensing Systems for Agricultural Optimization and Phenotyping III’ Conference Best Paper Award, 2018
- Award J. Paul Riley AWRA Paper Competition, 2017
- Outstanding Master's Thesis Award issued by IRAN Water & Wastewater Association

The most recent award for the “Best Reviewer 2018" from the Remote Sensing Journal (MDPI) was presented to Mahyar for the quantity, timeliness, and quality of his reviews in 2018. Mahyar was one of only five reviewers worldwide to receive this top award, and one of only two in the United States.

Mahyar’s major professor, Dr. Alfonso Torres-Rua, said, “His approach to science and research has yielded interesting and innovative ideas for Irrigation Engineering that go beyond what was planned for his studies. These new ideas are promising and provide practical solutions to the complexity of Evapotranspiration in complex vegetation environments like vines and orchards. Mahyar is a student with three major characteristics of an investigator: a passion for learning, a drive for acquiring the necessary knowledge for the area under study, and the ability to combine different fields and areas of expertise to address a scientific topic. These characteristics are remarkable for a student in a non-native country, studying also under a foreign advisor. As his mentor, I can see him after his Ph.D. with a brilliant professional life in either academia or industry where his skills and acquired knowledge will be of high value.”

We sat down with Mahyar to find out a little more about his research and time at the UWRL.

Mahyar presents research at Utah State University for 2017 AWRA competition.
Tell us more about your area of research.

Evapotranspiration is a key factor in energy and water balance models and crop water use estimation. Satellites and UAVs provide the necessary information to estimate the water and energy balance components at the spatial scale. However, UAVs provide that information at a higher resolution. Although the higher the resolution, the more detail in the image, increasing the resolution highlights the importance of “scale” issue in those models, especially ET remote sensing models. For example, the spatial resolution of Landsat is 30 m, so the output of ET models is limited to that pixel resolution. Similarly, some of the inputs to ET models such as leaf area index, resistance, and wind profile are not designed for the 10-cm resolution data from the AggieAir UAVs. Besides, at higher resolution, some features such as shadows emerge, but those factors were overlooked in ET models working at satellite pixel resolution. That’s why ET models must be refined to be executed at a higher resolution. In addition to the scale issues and overlooked factors, incorporation of point cloud datasets into ET models is untouched. Point clouds can be transferred to information such as canopy height, canopy volume, and canopy surface area that could be possible descriptors to map shadows on the ground, to estimate biomass parameters such as leaf area index, and to partition the radiometric temperature into canopy and soil temperature. These types of point cloud applications could enhance the performance of ET models when running at higher resolution. My main research area is to incorporate the information from Aggie Air UAV imagery, particularly point cloud, into the TSEB model to improve the accuracy of ET estimation at a higher resolution.

I’m working on improving remote sensing evapotranspiration models, particularly the Two-Source Energy Balance model (TSEB) based on the information that we can obtain from super high-resolution imagery (finer than 20cm in visible bands and finer than 1 m in the thermal band) captured by Unmanned Aerial Vehicles (UAVs). The products of UAV imagery consist of reflectance at different wavelengths and 3D information of objects called “point cloud.”

What inspired you to choose this field of study?

I think the role of “water” in macro and micro scale will be more and more highlighted in the incremental phenomena such as deforestation, flood, wildfire, melting polar ice sheets, drought, etc.,. It would be a reasonable decision to allocate our limited time to studying these types of research if we are interested in keeping our environment alive. In addition to the key role of water in our life, “electromagnetism” has always been an interesting topic for me since “it is not seeable, but it is sensible.” I think the importance and applications of “Electromagnetic Energy” have not been completely explored by researchers. I believe that electromagnetic energy is the only “unique language” that makes the possibility of a connection between all objects in the world. It is super-fast, contains major information of an object, and it doesn’t need to be “learned.” Any research idea that connects “water” and “electromagnetic” will be attractive to me. I couldn’t ask for a better project; “Remote Sensing in Agriculture” is exactly a bridge between these two topics.

What brought you to the UWRL?

In addition to the encouragement from my parents, pursuing my academic destination and obtaining my Ph.D. degree was a big dream. After the master program, I started applying to the best universities. I got some unofficial acceptance from different universities, but the projects that I was offered to work on were not quite a match with my background and my desire. One day, I saw an advertisement on a “hydrology group” in a Google forum from a new faculty member at USU looking for two Ph.D. students for a very interesting project in “Food-Water-Energy” from a very decent department in water resources research, the Utah Water Research Laboratory. Immediately my fiancée and I sent our CVs to the corresponding advertiser, and after two interviews we got full scholarship offers. That was one of the best days of my life. One day before coming to the U.S., we got married, and we started our Ph.D. degrees in January 2016!
How has your background influenced your research and teaching?

My master thesis was related to developing a machine learning tool to detect a pollutant in a river-reservoir system. That model has been written in MATLAB and coupled with a multi-objective evolutionary algorithm for auto-calibration. Since the machine learning models were kind of a hot topic at that time to many students in the university where I graduated (University of Tehran) and they were eager to learn such models, I was invited to organize workshops and teach them the theory and coding of those applicable models in MATLAB. In addition to the series of workshops, I was a TA for a water resources management class in the Master’s period. Knowing the physical relationship between water balance components from my TA experience, along with the ability of programming, particularly to develop Machine learning tools, provided a variety of opportunities when I was applying for decent universities and seeking for a full scholarship.

What is your favorite part of your research?

My favorite part of my research is just a moment: the moment that I think I found a thing that has been hidden so far. I love exploring, and finding anything that is still untouched and new feeds that feeling. In that moment, I feel my brain is like an uncontrolled hot spring getting warmer as the depth from the surface increases, allowing thoughts and ideas to escape from my brain and decrease its internal pressure. My favorite part is just that moment!

What is the most challenging part of your research?

I’m working on high-resolution remote sensing imagery. In some cases, data are too heavy to process, and analyzing the data or evaluating ideas takes a lot of time. I have to clip the data for a small part and test a hypothesis on that small area. Sometimes I get a very good result, but when I run the code for the entire image, it doesn’t work. I think working with “Big Data” such as UAV high-resolution imagery covering a large scale is always challenging.

What are your career goals?

My career goal is to be involved in a research team focusing on advancing new technologies in remote sensing and precision agriculture. Although sometimes research can be very challenging, I think it keeps me motivated and keeps my mind active. Redundancy gets me down. I don’t want to be a member that eventually can be replaced with a machine! I believe that every behavior of humans can be simulated by robots but emotions and creativity. That’s why I want to have a job that is challenging and inherently keeps me updated, makes my mind active, keeps me optimistic about the future and gives me a feeling of thriving every day. I need such a job to keep my emotions and creativity alive!

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Want to learn more about Mahyar's work? Follow him at

www.mahyarona.com

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