JOHNS HOPKINS
Center for Environmental & Applied Fluid Mechanics

FALL 2021 CEAFM VIRTUAL SEMINAR SERIES

"An Infrared Quantitative Imaging Technique (IR-QIV) for Remote Sensing of Surface Water Flows"

Presented by Prof. Edwin A. (Todd) Cowen, III
Cornell University
Department of Civil and Environmental Engineering
Hosted by Rui Ni (MechE)

Stage and discharge are some of the oldest measurements in environmental fluid mechanics and are vital in forecasting water supply and flood safety. These measurements are traditionally manpower intensive, hence expensive, and dangerous under high flow conditions. Considering climate change and the planet's increasing population there is a critical need for better, more accurate, and frequent, in space and time, data for model and forecast guidance. This need spans monitoring small-scale turbulent processes to calibrating and nudging continental scale river dynamics models. Driven by applications from river gaging networks to fisheries management to flood and erosion forecasting, and more generally, the near-shore environment of lakes, estuaries and the coasts, remote sensing with quantitative imaging tools is a rapidly expanding field. Such tools can be deployed from fixed platforms, drones, planes and satellites with valuable information contained within the visible to infrared spectral bands.

In this presentation we focus on using a remotely mounted infrared (IR) camera to monitor the surface velocity field of rivers and how bathymetry, flow rate and metrics of surface turbulence can be inferred from the collected IR images. We will provide an overview of our developed infrared quantitative imaging technique (IR-QIV), which is capable of measuring instantaneous velocity at high spatial and temporal resolution, over spatial domains with length scales of order 10 – 1000 m (*i.e.,* areas of 10^2 – 10^6 m^2) without the use of artificial flow seeding or illumination. We describe key similarities and differences relative to current visible light based techniques (*e.g.,* Large Scale Particle Image Velocimetry, or LSPIV), how to minimize uncertainty in the measurements, and how to use the physics of open channel flows to calculate the bathymetry from remotely measured turbulent integral length scales of the flow and leverage the measured surface mean velocity field to calculate the flow rate at a river cross-section. We will present results from field measurements, made in collaboration with the United States Geological Survey (USGS) and the California Department of Water Resources in the Sacramento–San Joaquin River Delta, CA, USA. In particular we will compare state-of-the-art acoustic approaches used by the USGS to measurements of both mean flow and turbulence made by our IR-QIV technique.

Friday, October 29, 2021 at 3:00 PM

https://wse.zoom.us/j/93762992307