# Environmental and Water Resources Engineering Seminar Series Presents:

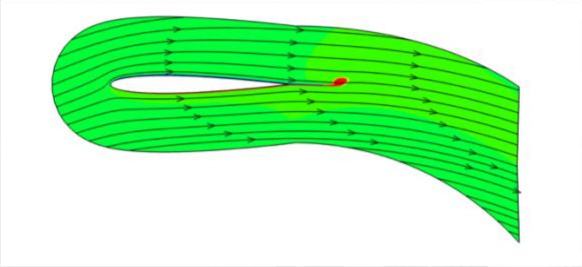
## Thursday, October 31st 2024, 3:30-4:30 pm, ECJ 1.308

*Zoom Link: https://utexas.zoom.us/j/98365720816*

## VIScous Vorticity Equation (VISVE) Method Applied to Flow Around Stationary and Rotating Hydrofoils

Zahra Seyedsharifi

*MSc in Water Engineering and Hydraulic Structures (Sharif University of Technology, 2022)*
*Advisor: Dr. Spyros A. Kinnas*



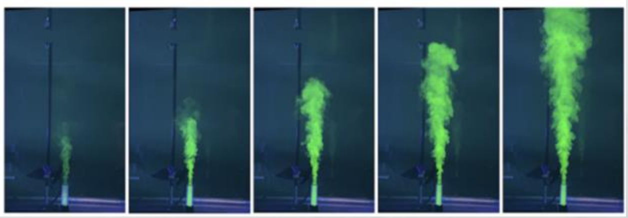
The VIScous Vorticity Equation (VISVE) method solves the vorticity transport equation, offering a more localized and compact representation of complex fluid flows compared to traditional methods. A particularly promising application of VISVE is in the analysis of vertical-axis wind turbines (VAWTs), where rotating hydrofoils play a fundamental role. Understanding the fluid dynamics around these rotating blades is key to optimizing turbine efficiency and performance. Our research applies the VISVE method to investigate viscous flow around both stationary and rotating hydrofoils. We obtained key flow characteristics, including vorticity, velocity, and pressure distributions, and analyzed them. To validate the accuracy of VISVE, we compared its results for both stationary and rotating hydrofoils with those obtained from traditional Reynolds-Averaged Navier-Stokes (RANS) simulations. The comparisons show good agreement between the two methods, confirming that VISVE can capture essential flow features with a high degree of accuracy. Beyond accuracy, VISVE results show several advantages over RANS results, particularly in terms of computational efficiency.

## Identifying and Characterizing Edge Features of a turbulent buoyant plume

Biman Kalita

*M.Tech*
*Advisor: Dr. Blair A Johnson*

Turbulent plumes are fascinating to study in large part due to the ability to see the eddies and structures that comprise the exterior structure as they develop in space and time. We perform a laboratory study in which positively buoyant turbulent plumes are generated in a quiescent water tank. Buoyancy is varied by modifying the relative percentages of isopropyl alcohol to water in a mixture placed in a head tank. Photographs captured at steady frame rates record the evolution of the plume as it develops in time and space. A custom algorithm tracks the visible exterior outline of the plume, from which eddies and structures can be identified along the interface between the plume fluid and ambient fluid. Statistical analyses are performed to characterize differences in the distributions of external structures to study their dependence on relative buoyancy between the fluids. Spectral analysis of the edge signal of the plume reveals a −2.2 slope, indicative of the range of eddy lengths that comprise turbulent plumes. We explore the relationship between buoyancy with both the plume front velocity and plume spread angle. We find the front velocities to be functions of both the buoyancy and source Reynolds number. However, the spread angles were found to vary only with buoyancy of the plumes, thus proportional to their Richardson numbers.



**EWRE Seminar Committee Members: Azalea Norwood, Elle Henson, Hiromu Koyama, Priyanshu Gupta, and Zijie Zheng**
**Faculty advisor: Dr. Kerry Kinney**