

Video Image Analysis of Turbulent Buoyant Jet Plumes Using Lab Simulations

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Turbulent buoyant jets occur in many different environments on our planet. From natural plumes seen in hydrothermal vents to manmade plumes seen in smokestacks and oil spills, turbulent buoyant jets are all around us. Knowing the volumetric flow rates of these jets can be of critical importance, but measuring these flows is often quite difficult. We are developing methods to quickly and accurately determine the flow rate of a turbulent buoyant jet using video image analysis. We developed a laboratory apparatus capable of emitting a turbulent buoyant gas jet (CO₂ and/or Nitrogen), with an adjustable flow rate and an adjustable density contrast. The emitted flow is seeded with water droplet “fog”, allowing the jet to be imaged with a video camera. The nozzle can be arranged in any orientation, but in this work we focused mainly on plumes emitted horizontally into the ambient air. We developed a Matlab function to trace the plume centerline and compare this to theoretical predictions of the trajectory. We are currently working to constrain several theoretical parameters that are not well known, including one describing the spreading rate of the jet. In the future we will be able to use trajectory analysis methods to determine the velocity and flow rate of turbulent buoyant jets.