Characterizing Sprays Using High-Speed Imaging and X-ray Analysis

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**Background**
- Multiphase flows occur when one or more dispersed phases flow in a continuous fluid phase that may also flow.
- The current study involves spray atomization, where water and air flow together and break up the water into very small droplets.
- Sprays have a multitude of applications in several aspects of engineering: fuel injection, food processing, chemical manufacturing, etc.
- Sprays are not the easiest to study as they are volatile and many of the behaviors that are studied are very small.
- Studying sprays will help further the efficiency of existing processes.

**X-ray/White Beam Imaging**
- When visualizing multiphase flows it is essential that we use non-destructive evaluation methods as to not alter the behavior of the observed event.
- X-ray imaging is a method that allows us to see inside opaque vessels without disturbing the flows.

**CoM and Frequency Analysis**
- The yellow line in the images represents the Center of Mass (CoM).
- The spray has a CoM that will oscillate as a function of time.
- When M = 5 the CoM follows the center of the intact liquid core.
- When M = 56, the liquid atomizes much closer to the nozzle exit and the CoM follows the center of the spray regions.

**Liquid Core Analysis**
- Above is a graphic showing the technical terms regarding a liquid core that are present in a spray.
- The momentum flux ratio (M) is defined as the ratio of gas momentum to liquid momentum.
- When M = 25, the liquid core area is relatively large.
- When M = 56 the liquid core breaks up quicker than when M = 25.

**Future Work**
- Image data from other flow conditions from this experiment will be analyzed to generate future results.
- Simultaneous backlight and white beam images are being analyzed to correlate the two imaging methods.

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