U.S. ARMY COMBAT CAPABILITIES DEVELOPMENT COMMAND

DESIGN OF A TEST METHODOLOGY TO SIMULATE RAIN ENVIRONMENTS

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BACKGROUND INFORMATION

- **Advanced impact sensors are being integrated into fuze designs**
  - MEMS switches
  - Accelerometers
- **Rain impact testing is needed to prove out the switches ability to perform in harsh rain environments**
- **Unfortunately, rain impact testing is extremely costly and there is currently no facility capable of conducting these tests**

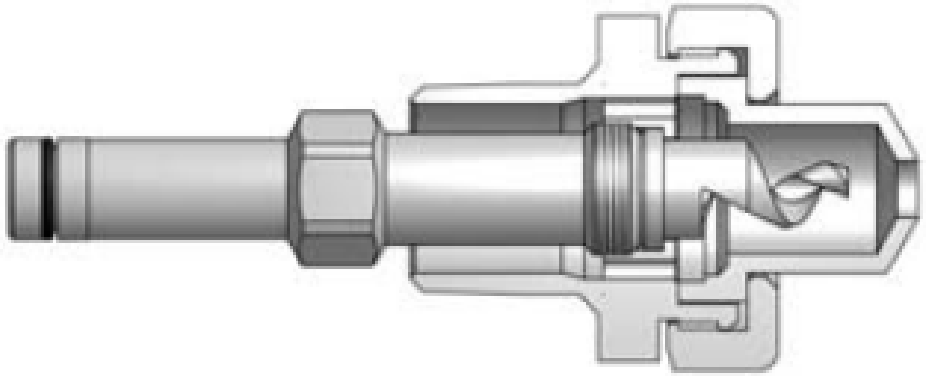
Due to high cost and low testing availability there grew a need to create a low cost solution to test sensor's performance in harsh rain environments

RAIN TEST FUNCTIONALITY

- **A BETE SpiralAir high flow air atomizing nozzle was used to emulate a rain field**

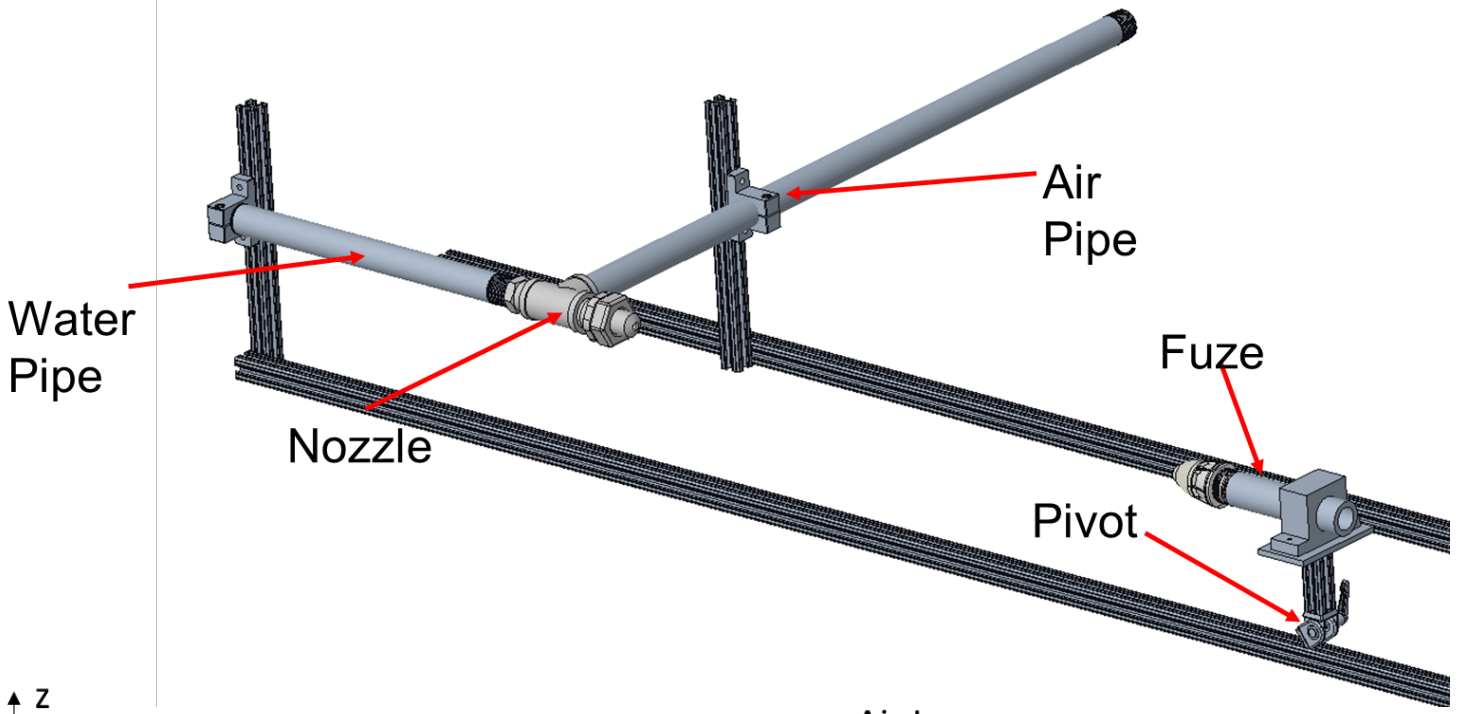
- **Droplet size is variable**
  - Altered by varying the pressure of the water and the pressure of air entering the nozzle
    - Droplet sizes vary up to 1 mm

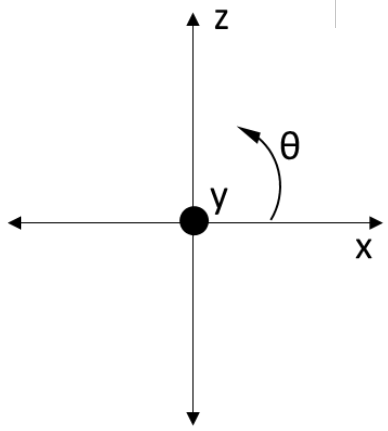
- **Rain field velocity is variable**
  - Altered by varying the flow rate of water and air entering the nozzle
    - Up to 20 m/s

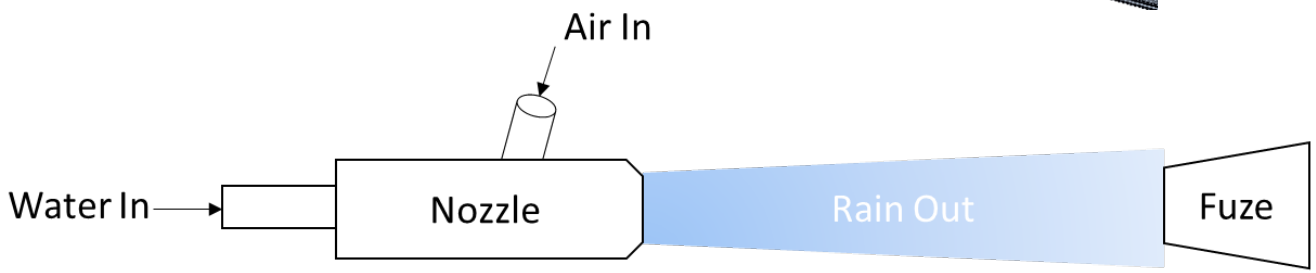


Flat Fan 60°

RAIN TEST FUNCTIONALITY







Fuze movement in x, z, and θ direction

RAIN TEST FUNCTIONALITY

RAIN TEST FUNCTIONALITY

CONCLUSIONS

- An instrumented fuze was tested to show closure of the impact sensor can be monitored during testing
- The velocity of the rain field was altered during testing along with droplet size
- The angle of the fuze relative to the rain field was also varied to understand the affect rain impact location on impact sensor sensitivity
- Total cost to build the test was under $10k

FUTURE WORK

- **More funding is needed to better characterize the rain field to verify that it is sufficient enough to emulate a harsh rain environment**
  - High speed cameras will be needed to record the test to elucidate velocity, liquid water content, and exact droplet size
- **Current nozzle is capable of producing a rain field up to 20 m/s**
  - Increased velocity is needed to better represent tactical environment
- **Droplet size of 0.5 mm does not properly represent the impact of larger (2-4mm) droplets**
  - A new nozzle may be needed to create larger droplet sizes