Flow Visualization Report – Fog and Ventilation Flow

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Context and Intent

This image was created for the Flow Visualization assignment, *Team First*. The purpose of the image is to capture how fog interacts with environmental airflow patterns; specifically, how a ventilation system influences the motion of fog particles in an indoor setting. The intent was to visualize the transition between turbulent and laminar flow regions within a confined environment. Early trials involved placing the fog machine at different distances from the vent and adjusting ambient airflow. The final image was chosen for its distinct layering effect, showing chaotic turbulence near the lower region and smooth laminar drift near the top left corner as the fog moves toward the vent.

Flow Apparatus and Physics

The setup consisted of a standard theatrical fog machine positioned approximately 1 meter from a ceiling ventilation intake. The camera was placed about 0.8 meters in front of the fog source, oriented horizontally across the airflow path. The fog, composed of water and glycol vapor, was ejected horizontally into the surrounding air and immediately influenced by the suction of the vent, resulting in complex flow structures.

The dominant forces in the flow are buoyancy, viscous drag, and pressure gradients created by the ventilation system. Near the fog source, the Reynolds number can be approximated using the characteristic velocity $U = 0.5\, m/s$, characteristic length $D = 0.05\, m$, and the kinematic viscosity of air $\nu = 1.5 \times 10^{-5}\, m^2/s$:

$$Re = \frac{UD}{\nu} = \frac{(0.5)(0.05)}{1.5 \times 10^{-5}} \approx 1666$$

This value places the flow in a transitional regime, explaining why turbulence dominates near the fog source but becomes more laminar near the vent. The flow reveals how suction-induced shear layers and pressure differentials govern particle transport.

Visualization and Lighting Technique

Fog visualization was achieved using a consumer-grade fog machine operating with water-based fog fluid. The fog density was moderate, producing a semi-transparent mist that revealed airflow while avoiding total opacity. The experiment was conducted indoors under no ambient light to enhance contrast. The only light source was a phone flashlight positioned below the fog machine, emphasizing edge scattering and volumetric illumination.

Photographic Technique

The photograph was captured using a Canon EOS Rebel T3i DSLR in manual mode. The field of view spans approximately 0.6 m, and the distance from the fog stream to the lens was around 0.7 m. A 50 mm prime lens was used, allowing for shallow depth of field and strong subject isolation. Camera settings were f/4 aperture, 1/80 s shutter speed, and ISO 200. These settings were selected to balance adequate light intake with minimal motion blur while maintaining sharp texture in the fog.

The image was shot in sRGB color space with a resolution of 5184 × 3456 pixels, yielding a detailed 18-megapixel RAW image. Post-processing adjustments were minimal and done in Adobe Lightroom: contrast +10, clarity +15, shadow +8, and a small crop to center the flow. The edits preserved the integrity of the fog’s natural structure while enhancing visibility of the laminar and turbulent regions.

Image Evaluation

The image effectively captures the interplay between laminar and turbulent flow, illustrating how environmental airflow shapes fog dispersion. The smooth transition from chaotic motion to a calm drift near the vent provides strong visual contrast and insight into flow stability. I particularly like how the lighting emphasizes the texture and density variations within the fog. However, some areas appear overexposed, slightly washing out finer vortices.

If I were to repeat the experiment, I would use a higher shutter speed or directional spotlight to better freeze the turbulent region without blur. Overall, the image fulfills my original intent of visualizing controlled indoor airflow and demonstrates the coexistence of laminar and turbulent motion in a single frame. Future iterations could incorporate colored lighting or flow markers to highlight vortex motion in three dimensions.

Sources

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