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COLLEGE OF ENGINEERING
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Plasma Jet Flow Characterization via Computational Modeling

Declan Brick[1], Gabe Xu[1]

1. Department of Mechanical and Aerospace Engineering, UAH

Introduction

-Atmospheric Pressure Plasma Jets (APPJs) can perform various biological and material treatments due to plasma generated chemistry
-Recently[1], an APPJ at UAH was experimentally characterized across varied operating conditions
-However, the APPJ has yet to be modeled, which allows further characterization
-Here we model the flow structure of the APPJ and compare to similar results[2]

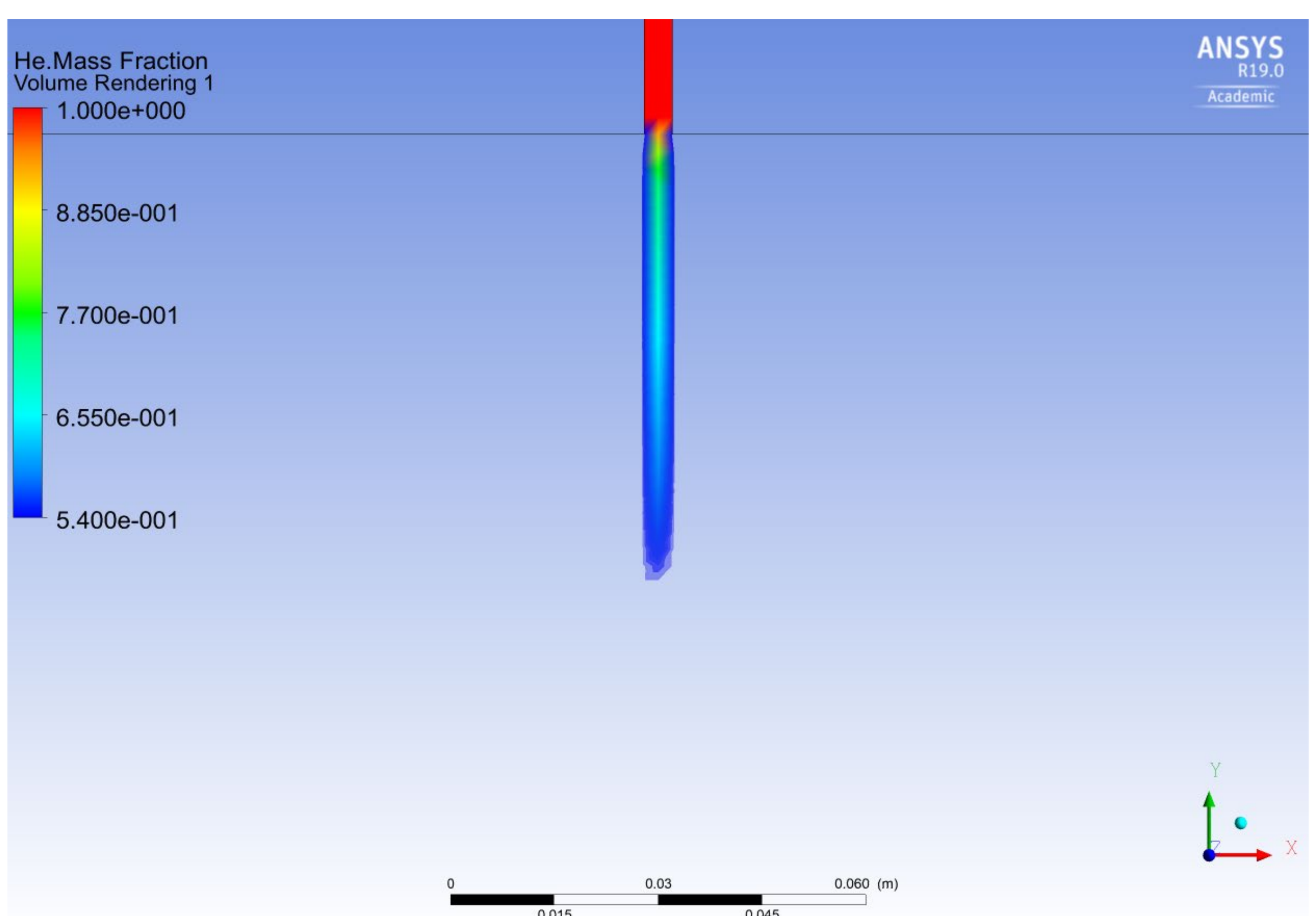

Figure 1: Jet as seen in post-processing, 3.98 m/s flow rate

Model

-We employ ANSYS Fluent, a commercial Computational Fluid Dynamics software to model the 2D flow of the jet
-For turbulence modeling, we use the RNG k-epsilon model as it is a robust turbulence model that accounts for small scale mixing that is important in APPJ behavior
-To model the interactions between the flowing helium and ambient air we use the Species Transport model without chemical reactions

References

1. DOI: 10.1109/TPS.2019.2942576
2. DOI: 10.1088/0022-3727/43/15/155202

Results

-We determine the minimum helium mass and mole fractions needed for jet propagation
-Then we plot the minimum values against inlet flow rate, as seen in Figures 2 and 3
-The trend agrees with the results found in[2] and is explained by additional mass at higher flow rates

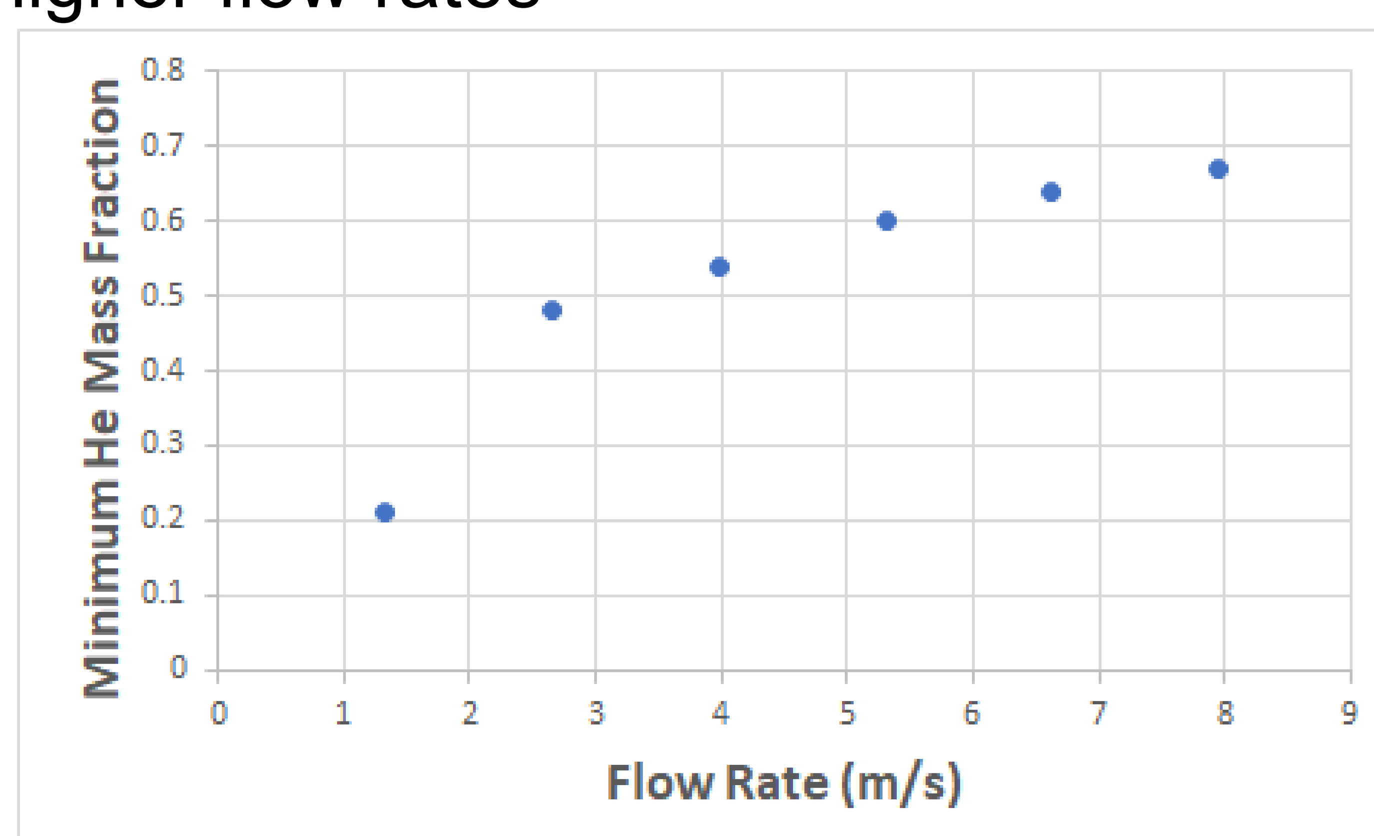

Figure 2: Minimum Mass Fraction vs. Inlet Flow Rate

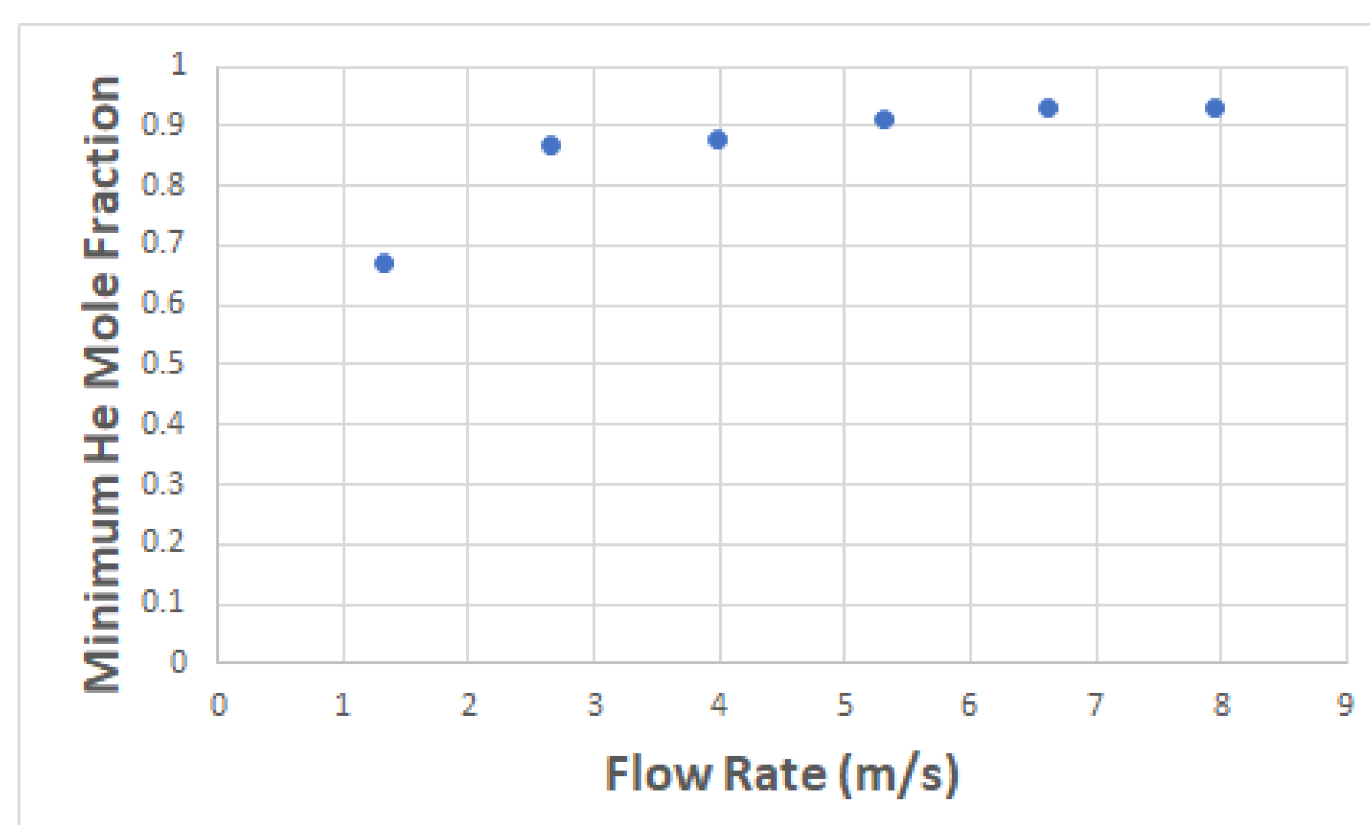

Figure 3: Minimum Mole Fraction vs. Inlet Flow Rate

Future work

-We plan to further model the flow using a Smoothed-Particle-Hydrodynamic (SPH) method rather than Fluent's meshing-based method
-We plan to model the E/M behavior of the APPJ in SPH to characterize its key plasma properties

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