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Future Engines & Fuels Laboratory

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CFD Analysis of Mixture Preparation with DMF/Ethanol in GDI Engines

Introduction

Biofuels obtainable from renewable sources have attracted recent interest. The ultimate goal of current research is the conversion of the most abundant renewable hydrocarbons and lignocellulose into liquid fuels for motor vehicles. In 2007, a paper from Nature describes a two-stage process for converting biomass-derived sugar into 2,5- dimethylfuran (DMF).
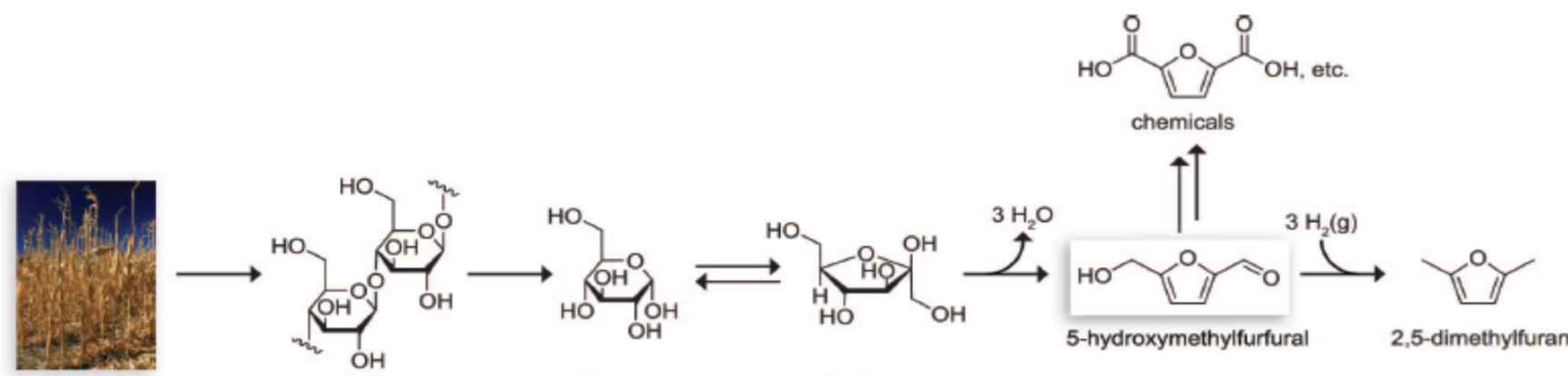

Figure 1 Conversions of Biomass into DMF
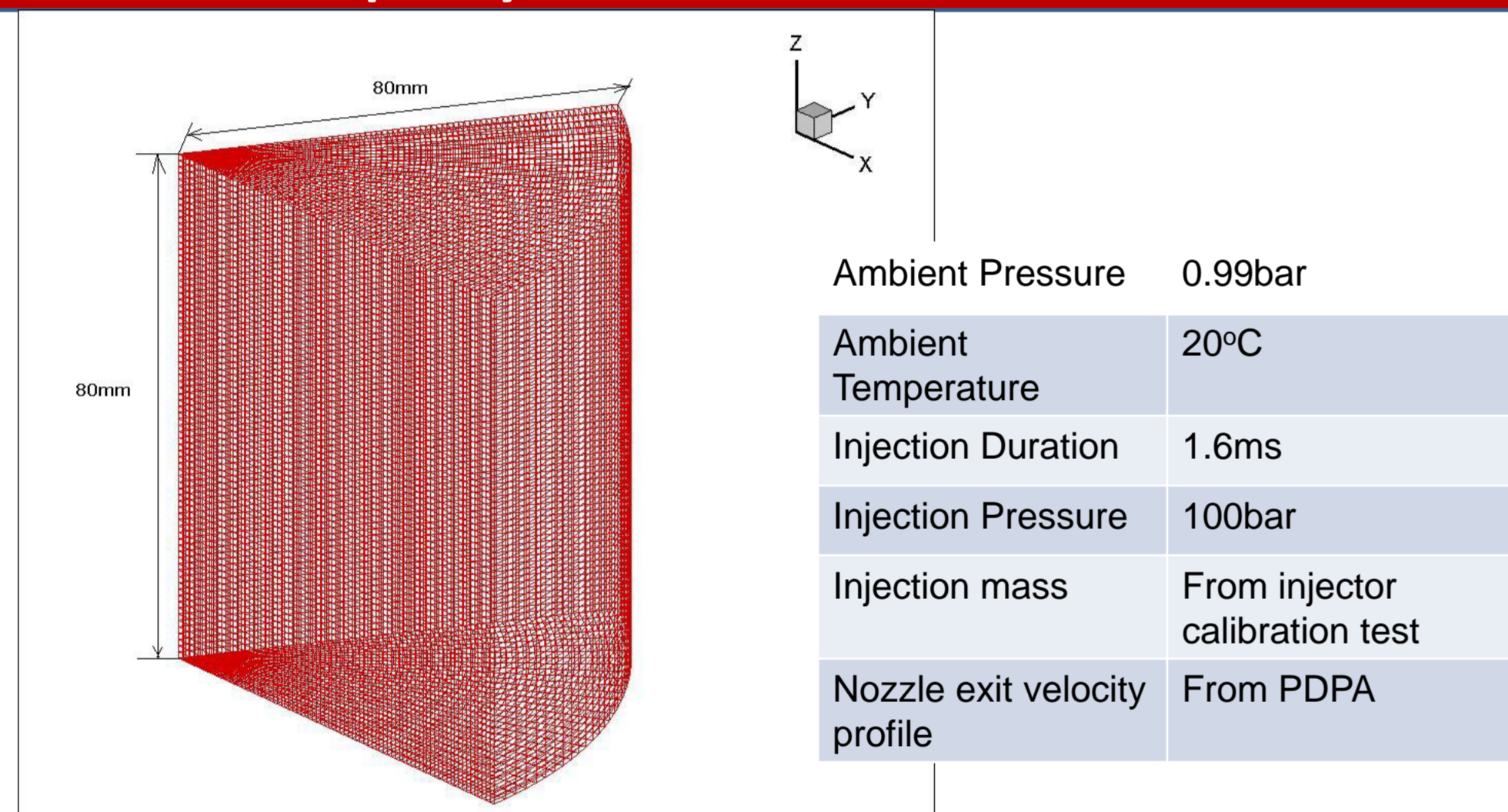
Spray Model Validation

Ambient Pressure	0.99bar
Ambient Temperature	20ºC
Injection Duration	1.6ms
Injection Pressure	100bar
Injection mass	From injector calibration test
Nozzle exit velocity profile	From PDPA

Figure 2 Mesh Generated for Validation and Boundary Conditions
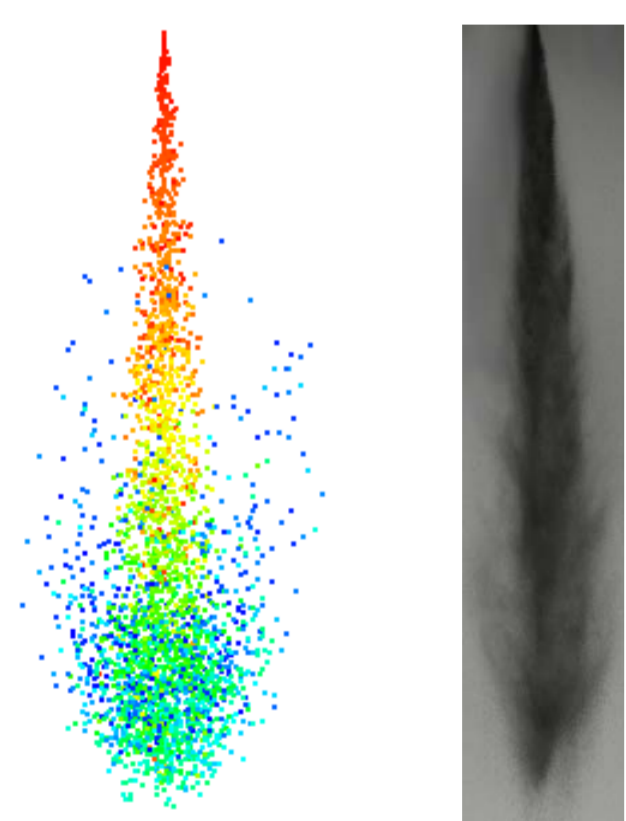

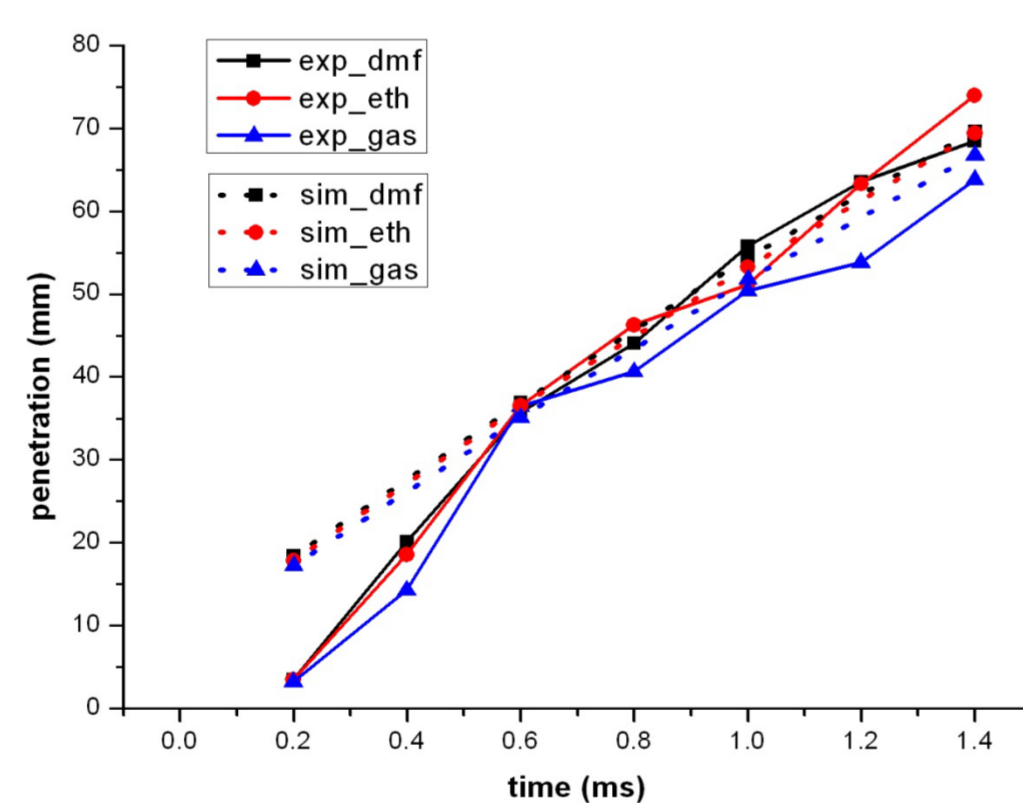**Figure 3** Numerical Results and Image Taken of Spray

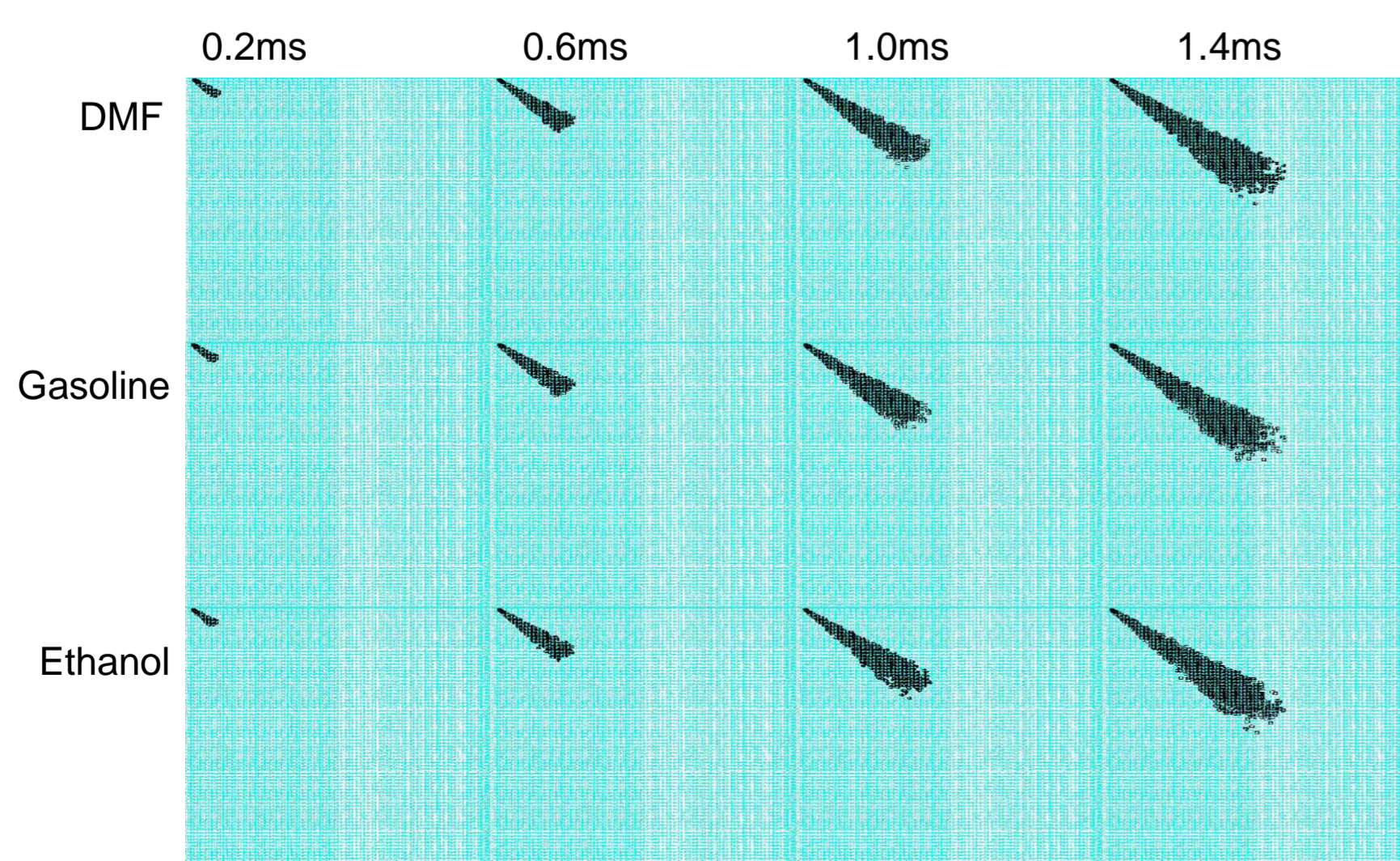**Figure 4** Comparison of Numerical and Experimental Results of Penetration

Figure 5 Numerical Spray Development
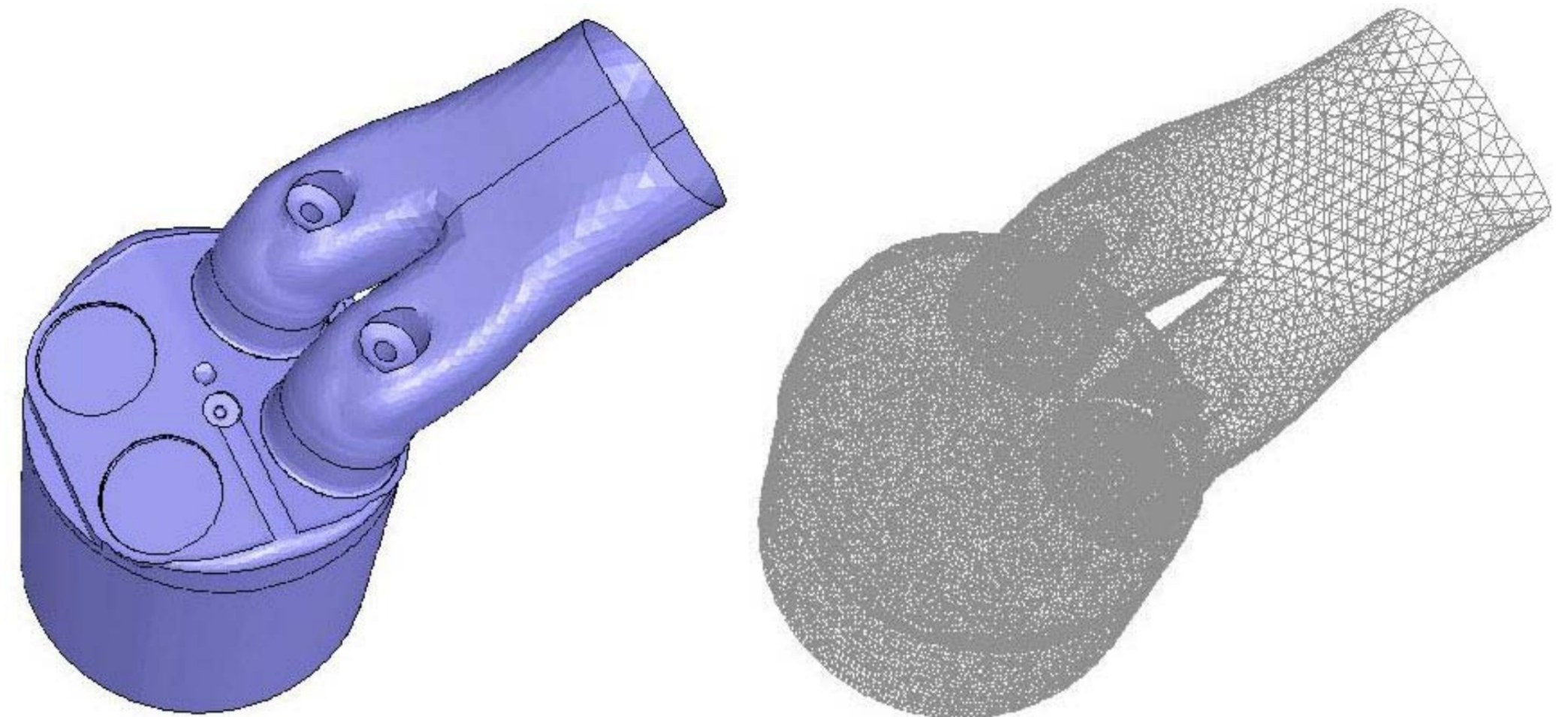
Spray Characteristics in Engine

Figure 6 Mesh Generated for Engine Cycle Simulation

Particle Traces Colored by Particle Diameter (mm)
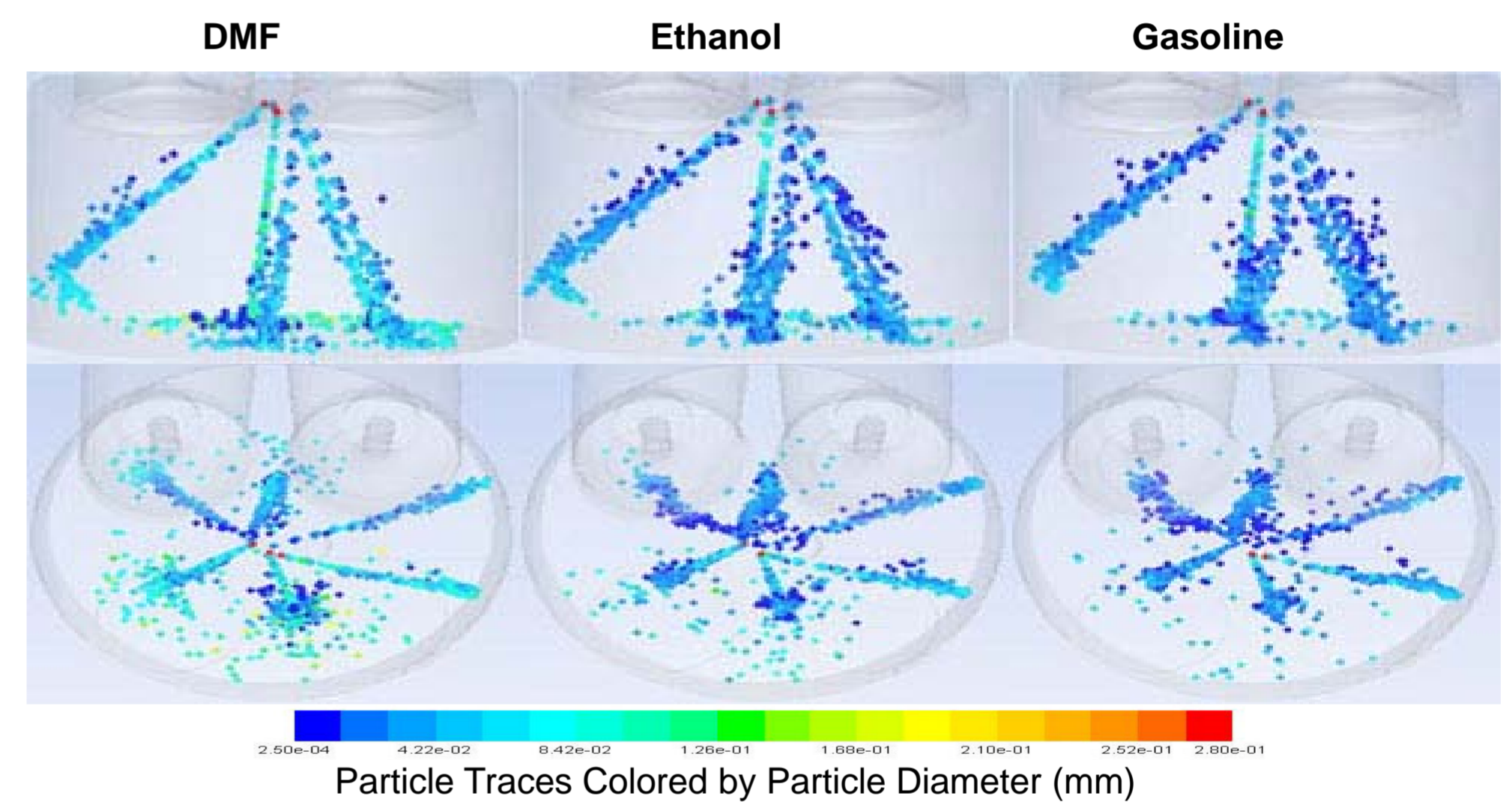

Fuel-oxygen-ratio

Figure 7 Particle Trace and Fuel-O_2 Ratio

All three cases are built up under the same injection pressure and injection duration.

1. spray development of ethanol and gasoline are similar, but as to the case of DMF, more big particles can be found.

2. the order of fuel concentration from high to low is gasoline, ethanol and DMF

Publication

1. Guohong Tian, Haiying Li, Hongming Xu, Yanfei Li and S.M. Raj, 'Spray Characteristics Study of DMF Using Phase Doppler Particle Analyzer.' *SAE paper 2010-01-1505*

2. Guohong Tian, Ritchie Daniel, Haiying Li, Hongming Xu, Shijing Shuai and Paul Richards, 'Laminar Burning Velocities of 2,5-Dimethylfuran Compared with Ethanol and Gasoline.' *Energy & Fuel,* 24 (2010), pp. 3898–3905.

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