Quantitative Analysis of Fuel Sprays by Ultrafast X-Tomography

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ABSTRACT

Detailed analysis of fuel sprays has been well recognized as an important step for optimizing the operation of direct injection gasoline engines to improve fuel economy and reduce emissions. However, the structure and dynamics of near-field multi-hole fuel injector sprays have not previously been visualized or reconstructed three dimensionally (3D) in a quantitative fashion. Using an ultrafast x-ray detector and intense monochromatic x-ray beams from synchrotron radiation, the interior structure and dynamics of multi-hole fuel injector sprays were elucidated for the first time by a newly developed, ultrafast computed microtomography technique. Many features associated with the transient liquid flows are readily observable in the reconstructed spray. Furthermore, an accurate 3D fuel density distribution was obtained as the result of the computed tomography in a time-resolved manner. These results not only reveal the near-field characteristics of multi-hole fuel injector sprays with unprecedented detail, but will also facilitate realistic computational fluid dynamic simulations in highly transient, multiphase systems.

Keywords: fuel spray, synchrotron x-ray, tomography

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