Real multiple orifice Diesel nozzle geometry by X-ray micro-CT for internal flow simulation

M. Santini*[1], S. Fest-Santini[1], P. Conti[1], G.E. Cossali[1], R. Dondé[2]
[1]Department of Industrial Engineering, University of Bergamo, Italy
[2]CNR - IENI, Italy
santini@unibg.it, fest@unibg.it, conti@unibg.it, cossali@unibg.it, donde@ieni.cnr.it

Abstract

Traditionally, CFD simulations of the flow inside fuel nozzles are performed on ideal meshes, obtained from the nominal nozzle geometry. The growth of disturbances which ultimately leads to disintegration of the liquid jet or sheet into ligaments and then into drops is affected by the real internal injector geometry, which differs usually from the nominal one due to fabrication tolerances, roughness, cavitation erosion, etc.

Micro-CT instrumentation allows investigating at micrometric resolution the internal injector geometry. The real three-dimensional geometry is reconstructed from a set of planar X-ray shadow images and the internal surface is extracted based on isogray-values out of the volumetric data set. The achieved accuracy depends mainly on the spatial resolution of the volumetric data set.

Production accuracy of injector can be controlled by superposition of nominal CAD geometry and reconstructed 3D volume (see Figure 1). The extracted surface itself can be used as boundary domain to perform CFD simulations in order to evaluate the effect of real geometry on the internal fluid-dynamics.

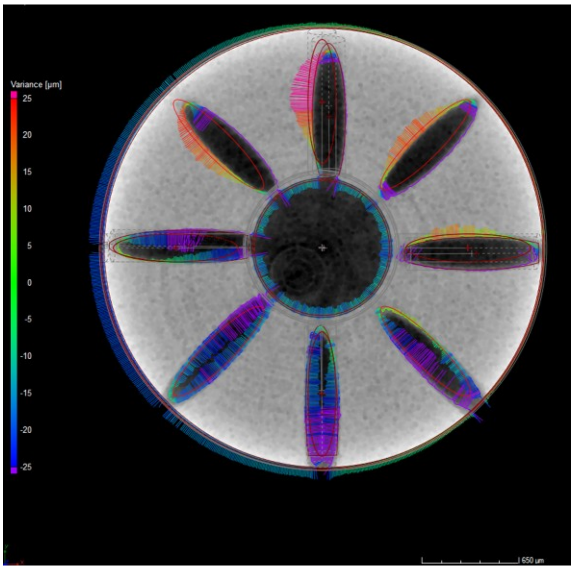

Figure 1: Difference of real and nominal injector geometry

The reported work shows the capability of the micro-CT technique to reconstruct the internal geometry of a real Diesel injector and to create a proper mesh to perform CFD simulations of the fuel flow inside the nozzle holes and cavity. Internal flows computed for real and nominal geometries are compared.