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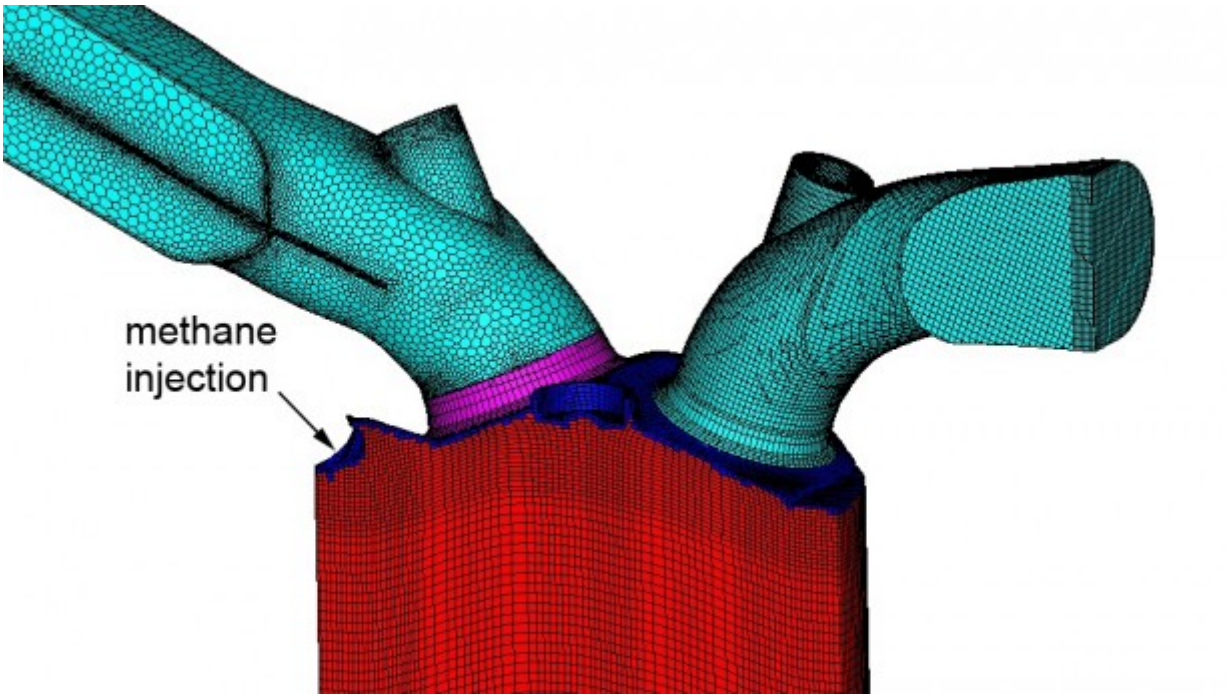
MULTIPLE CYCLE LES SIMULATIONS OF A DIRECT INJECTION METHANE ENGINE



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Abstract:

The complete engine process (inlet stroke, direct methane injection, compression, combustion and exhaust stroke) in a direct injection methane engine is investigated
using the Reynolds Averaged Navier Stokes (RANS) and the Large Eddy Simulation (LES) approaches offered by Star-CD. Single-cycle RANS and LES simulations based on k ? ? and k ? l turbulence models, were performed first to assess the potential improvement offered by LES. The model approaches of RANS and LES in the fields of wall heat losses and combustion are compared and the differences are discussed. Especially in the combustion modeling, LES show potential to simulate underlying physical processes more accurately. In addition, a method is proposed to derive appropriate model constants for the Gequation combustion model in a LES simulation. Afterwards, Star-CD is modified via user coding to allow multiple cycle calculations with G-equation, by resetting the species composition after combustion. To prove the concept, eight cycles are calculated which show turbulence fluctuations up to 14%, which is an important factor leading to cyclic fluctuations in internal combustion engines. In summary, LES shows promising results for a more predictive calculation of the flame propagation. The multiple cycle simulation also shows that LES is able to capture turbulence fluctuation from cycle-to-cycle.

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