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## A Comparison of Modeled and Measured 3-D In-Cylinder Charge Motion Throughout the Displacement of a Four-Valve SI Engine

The flow inside a combustion engine is highly complex and varies significantly with small changes in the engine configuration. For a long time IC-engine researchers have tried to predict the major mean flow patterns inside close-to-production engine setups. During the last decades computational fluid dynamics (CFD) has significantly contributed to the engine development process. Hence, significant research has focussed on the comparison of modeled and measured flows in IC engines. However, according to the knowledge of the authors, this study is the first fully three-dimensional (3-D), modeling and measurement effort that has evaluated the vast majority of the displacement volume by using an identical engine geometry. With improved, non-intrusive, 3-D velocity measurement technology, the vast majority of the cylinder displacement was explored and compared with Star-CD modeling results at the same locations. The majority of the ensemble-averaged, 3-D velocity data exhibited similar flow patterns and tumble numbers within the center of the cylinder. Significant flow differences were observed in the outer regions, close to the cylinder walls, as well as in the level and shape of the turbulence during the intake stroke. The flow differences found in this study confirm the need for developments in computational and experimental methods.

**Author Name:**

Hans G. Hascher  
Harold J. Schock  
Oshin Avanesian  
James Novak

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