Abstract Submitted
for the DFD09 Meeting of
The American Physical Society

Flow asymmetry and vortical structures behind a rotating tire
JOHN AXERIO, GIANLUCA IACCARINO, Stanford University — The wake behind both stationary and rotating tires is dominated by two strong counterrotating vortices. Experimental observations and numerical simulations have shown that one vortex may become stronger thus altering the wake dynamics and stability. The objective of this study is to investigate the main causes of near-wake and far-wake asymmetry. Factors such as tire camber angle, hub cavities, spoke geometry and the flow through the brake system, are all investigated as possible sources of asymmetry; it is shown that the most critical factor in flow asymmetry is the flow through the hub of the tire. When this is primarily in one direction (inboard to outboard side), the inboard vortex increases in size and intensity, eventually overwhelming the outboard vortex. We also study the transient features and timescales associated with the counterrotating vortex pair. Transient feature extraction is typically not possible with traditional techniques like PIV and RANS computer simulations. As a result, an LES simulation is used to extract eddy turnover timescales and vortex core trajectories for a rotating tire at Re=500,000.

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Date submitted: 07 Aug 2009 Electronic form version 1.4