AUTOMOBILE WAKE

2008 Award Winner

APPLICATION NOTE V3V-007

Wake flow is of great interest in many practical situations. In automobile industry, particular attention is given on flow around and behind an automobile to ensure the design to provide a safe, smooth and comfortable ride for the passengers. Flow around and behind the side mirrors of an automobile has significant effect on the noise generation. Flow in region between the the top and the rear of the automobile may contribute to the stability of the automobile when it is cruising on the highway. In particular, the postion of the spoiler, like the one shown in Fig. 1, determines the wake flow behaviour and allows the automoblile to accelerate more quickly to high speed with some effect on the downstream aerodynamics.

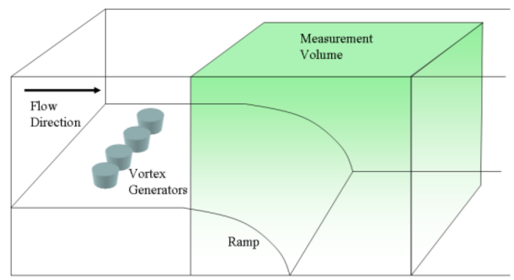

Fig. 1: Schematic of experimental setup and measurement volume.

In this experiment, the flow covering the entire region behind an automobile model was taken. The objective is to investigate the flow behavior in the volumetric region. With the employment of the V3V system, the instantaneous flow characteristics were revealed, showing wake flows behind the mirrors and the trailing flow toward the rear end of the model. Overall the measurement provides a holistic view of the flow behavior; hence it can facilitate changes on the automobile body and various parts to meet the aerodynamics requirement for the design.

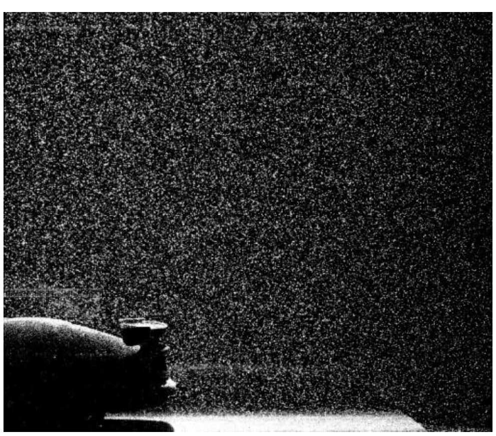

Fig. 2: Sample image from one of the V3V-8000 apertures.

The TSI V3V™ (Volumetric 3-Component Velocimetry) system was used to analyze the resulting flow structure. The flow was illuminated by a model YAG120-BSL 120 mJ dual-head pulsed Nd:YAG laser operating at 7.25 Hz and 532 nm wavelength. Light cone optics were used at the exit of the laser to shape the beam into an illuminating cone. The laser cone was formed with a -25 mm and a -50mm cylindrical lens mounted at 90° to each other. These cylindrical lenses diverged the beam in the horizontal and vertical directions to illuminate a volume approximately 120 mm × 120 mm × 60 mm. The model V3V-8000 3D camera probe was aligned and calibrated with the CCD a distance of approximately 800 mm from the back plane of the measurement volume. A sample image from one of the apertures can be seen in Fig. 2.

TSI and TSI logo are registered trademarks of TSI Incorporated.

The data capture was synchronized with the model 610035 synchronizer. The images were streamed to the model HYPER2 HyperStreaming® computer, and subsequently analyzed.

A single instantaneous V3V capture is seen in Fig. 3. Each instantaneous capture yielded between 10,000 and 15,000 independent vectors. In the plots, the red and blue isosurfaces represent positive and negative z-vorticity, respectively. The back plane represents streamwise velocity. Several x-planes of vectors are shown along with absolute streamlines shown in yellow. Notice that the presence of the rear spoiler has a dramatic effect on the z-vorticity in the immeadiate wake of the car. In addition, a recirculation zone is found downstream.

In this study, the flow structure downstream of car model was examined with the TSI V3V™ system. Instantaneous volumetric velocity fields were obtained, and the results were analyzed.

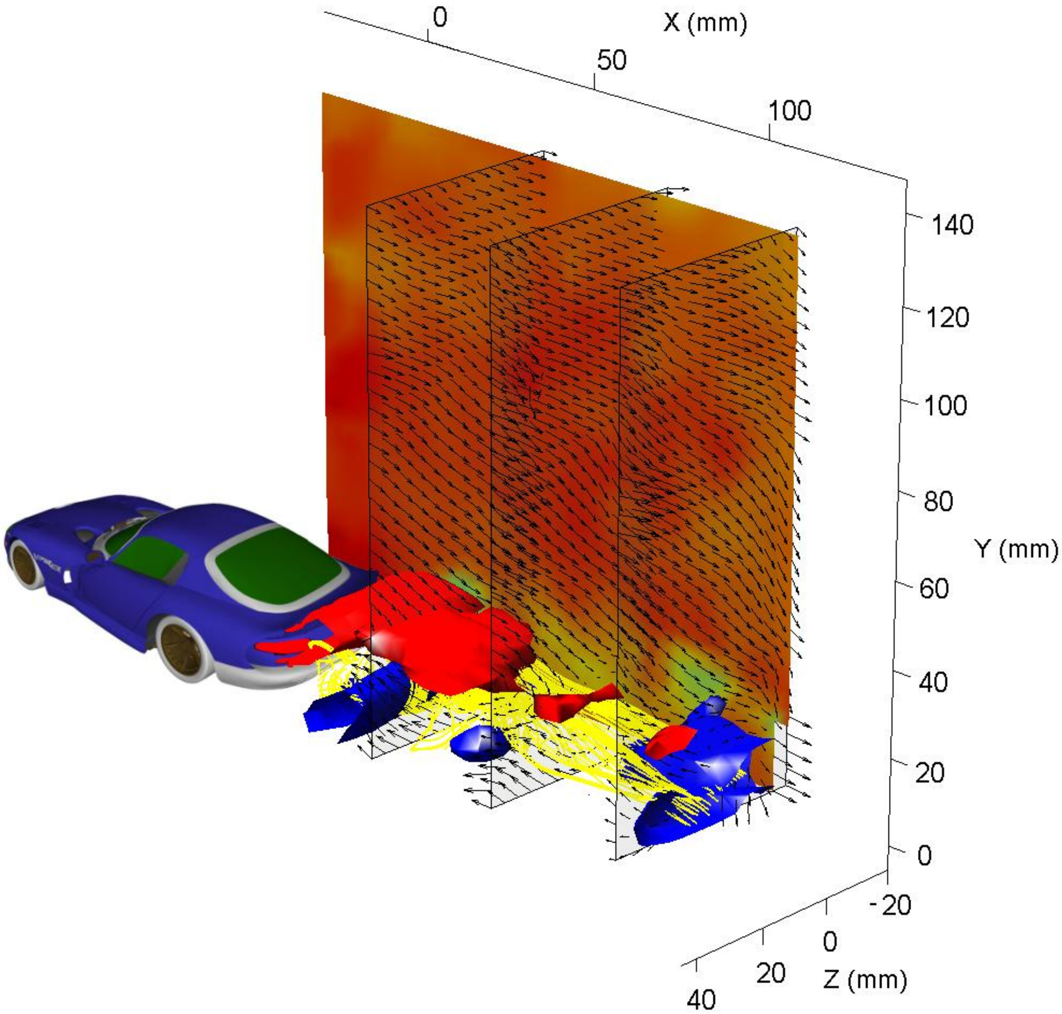

Fig. 3: Volumetric 3-component velocity field of the flow downstream of the vehicle. Flow is from left to right and out of the page. The back plane represents streamwise velocity. The red and blue isosurfaces represent opposite signs of z-vorticity. Streamlines are shown in yellow.

UNDERSTANDING, ACCELERATED

TSI Incorporated – Visit our website **www.tsi.com** for more information.

USA	**Tel:** +1 800 874 2811	**India**	**Tel:** +91 80 67877200
UK	**Tel:** +44 149 4 459200	**China**	**Tel:** +86 10 8251 6588
France	**Tel:** +33 4 91 11 87 64	**Singapore**	**Tel:** +65 6595 6388
Germany	**Tel:** +49 241 523030		

 ©2013 TSI Incorporated Printed in U.S.A.