

Measurement of Air Flow and Radiation Sound Distribution around a Vehicle and Rolling Tire Shape during On-Road Driving using a Still Camera and Mirror Images

Masao Ishihama ¹⁾ Motohiro Kanda ²⁾ Shouji Yuasa ²⁾

1) Ishihamagiken Consulting
2-27-15 Shonan Takatori, Yokosuka 237-0066, Japan (E-mail:ishihama@alum.mit.edu)

2) System Plus Co., Ltd.
13-8 Chigasaki-chuo, Tsuzuki, Yokohama 224-0032, Japan

KEY WORDS: aerodynamics, exterior noise, tire/wheel, Visualization, Sound Sources (F2)

We have developed a method for observing and photographing the following phenomena while driving on the road without using a large wind tunnel or high-speed cameras; i.e., 1) airflow around a vehicle body (Fig.1), 2) air flowing through wheel openings (Fig.2), 3) deformation of rolling tires (Fig.3) and 4) intensity distribution of noise sources on a vehicle surface. (Fig.4) The tools used are a) a mirror installed along the roadside (Fig.5) or on the bottom of a pit that dug down the road and b) a still image camera and an acoustic camera fixed on the vehicle body or on the rotating wheels. (Fig.2)

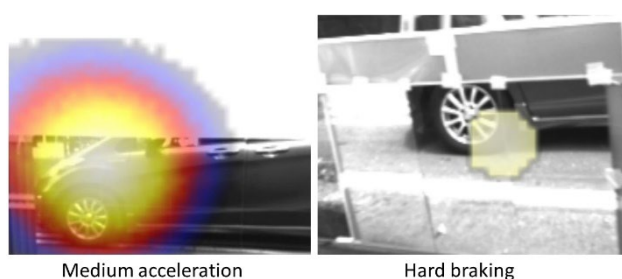


Fig. 4 Noise source distribution on a vehicle
Left: during acceleration, Right: during heavy braking



Fig.1 Flow visualization using light emitting particles

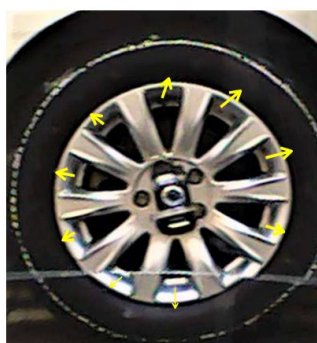


Fig.2 Airflow to the outside through the rolling wheel

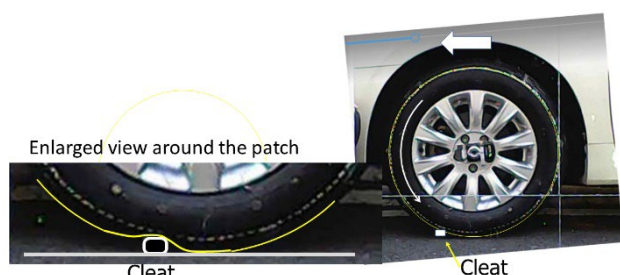


Fig.3 Deformation of a tire due to riding on a cleat

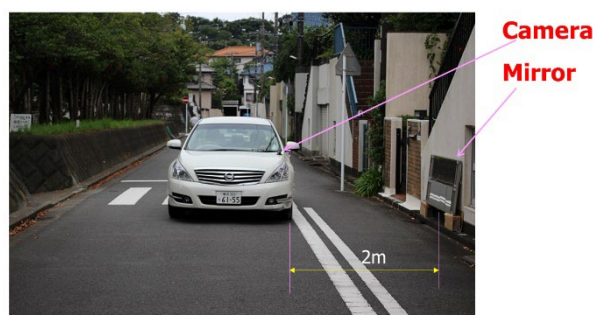


Fig.5 Typical arrangement on a road.

The following technical knowledges were obtained through this research..

- 1) Based on the principle that the relative position of an object and its mirror image is invariant, using a mirror and a camera attached to a moving object enables us to visualize the deformation of the moving object and the flow around it during actual operation.
- 2) Based on the above principle, using a mirror and a microphone array attached to a moving object makes it possible to visualize the acoustic power distribution around the moving object during actual operation.
- 3) By using a convex mirror in the above method, we can visualize the acoustic distribution at a wide angle together with the image.
- 4) Sound sources outside the field of view can be searched for by skillful placement of mirrors.