

ESTIMATION OF ROAD INFORMATION FROM RUNNING VEHICLE

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ABSTRACT - This paper suggests that pavement irregularity is extracted from the vibration acceleration data by independent component analysis (ICA). The concept is shown in Figure 1. Automobiles consist of many movable parts and, these are sources of vibrations. So, the vertical accelerations of unsprung masses are evoked by road irregularity, engine's vibration, suspensions' vibrations, and so on. Eight accelerometers are set up, and measured unsprung of the vehicle. ICA can divide an original signal from mixed signals. The road surface to measure is a known road surface and an unknown road surface. The known road surface is a tile road. The vehicle changed only the left rear wheel into 16 inches tire, 17 inch tire, and temporary tire. Figure 2 is acceleration of upright in upper stand and ICA in lower stand. From upper stand, the 17 inch tire has wide tread, so noise can be easily mixed. Also the amplitude of accelerations became large. The temporary tire's air pressure is high at the level of 460kPa, and it results in larger amplitude compared with the result of 16 inches tire. Similar waveforms are extracted in all tire patterns from the results of ICA on unknown road condition in lower stand. Therefore, the result of ICA extracted the same characteristics of road irregularity. Accelerations of uprights on known road are shown in Figure 3 upper stand. On lower stand, the independent component which has most similar shape to road irregularity is displayed on left; the PSD of the independent component is shown on right. Accelerations show some shift, but it is difficult to see the cyclic waveform of tile road. On the other hand, the independent component shown on lower left graph can find cyclic waveform with 0.017s cycle. The cycle time corresponds with road's gaps cycle. Also the PSD on lower right graph reads the peak frequency at tiles' frequency and its multiples, so the information of road irregularity was extracted from measured accelerations with ICA. Finally, the difference between dry and wet can estimate that PSD of ICA including the road information is derived.

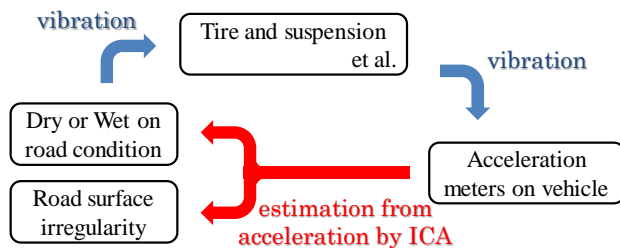


Figure 1: Concept

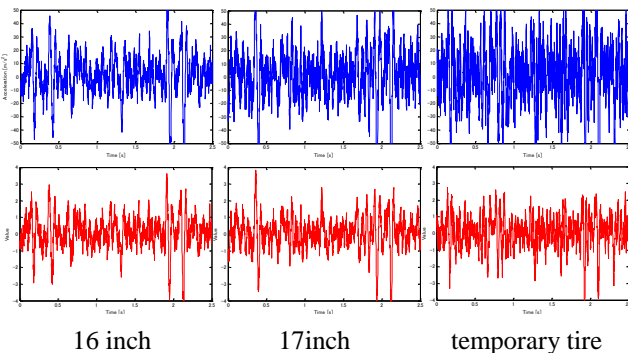


Figure 2: Comparison between upright acceleration and ICA

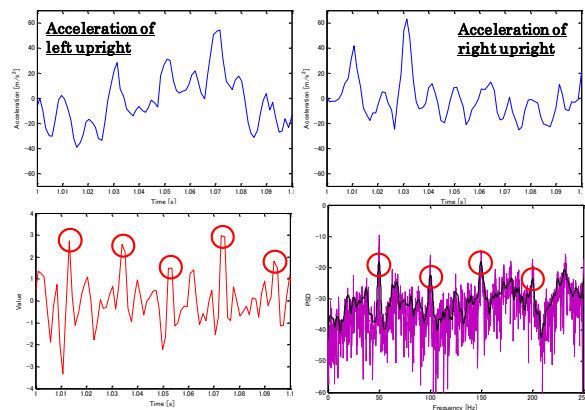


Figure 3: ICA result with the known road surface