



CALIFORNIA SCIENCE & ENGINEERING FAIR 2019 PROJECT SUMMARY

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Project Title FMCW Radar Driver Head Motion Monitoring Based on Doppler Spectrogram and Range-Doppler Evolution	
<p style="text-align: center;">Abstract</p> <p>Objectives Drowsy driving is one of the leading causes of road accidents. However, existing technologies such as the Driver Alert System by Volkswagen monitor the movement pattern of the vehicle rather than the driver. Other radar-based driver monitoring researches focus on vital signs and facial features recognition, which are not only difficult to separate from other body motions but also requires a very narrow and precise beamwidth. The object of this research was to determine if an FMCW radar could serve as a driver monitoring system.</p> <p>Methods A coherent FMCW radar was used to observe the changes in range and Doppler caused by five different head and neck motions: dorsal flexion, dorsal hyperextension, lateral bending, lateral rotation, and forward body motion. The Doppler and range signatures produced by these movements were analyzed using a range-Doppler evolution and a Doppler spectrogram. The Doppler spectrogram was created within the LabVIEW program by extracting Doppler history from the range-Doppler evolution and indexing the data to display Doppler information at a specific range. Preliminary experiments were performed to determine the ideal angle of inclination of the radar, and additional programming was added to make the prototype more resistant to errors.</p> <p>Results After analyzing frames of range-Doppler evolution and Doppler spectrogram, Doppler and range characteristics of dorsal flexion of the neck the motion indicative of low driver alertness were distinguished from those of other driver head and neck motions.</p> <p>Conclusions Ultimately, experiments demonstrated the potential of radar-based head motion detection as a driver monitoring solution. With the help of image-processing software, the radar-based head-motion monitoring technology can be implemented by itself or integrated with other sensing methods to serve as a reliable driver monitoring system.</p>	
Summary Statement This work demonstrates the potential of an FMCW radar to monitor driver's head motions with real-time Doppler spectrogram and range-Doppler evolution.	
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