ENSEMBLE SCATTERING AND RFI SPECKLE CAUSED BY COLLISION AVOIDANCE RADAR

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There has been considerable interest and research activity recently concerning automotive collision avoidance radars operating near 24 GHz. In particular, detailed and precise measurements have been made and electromagnetic models have been developed to describe the scattering properties of target automobiles when illuminated by such a device when mounted on an adjacent automobile. The dependence of the scattering on both angular direction and RF frequency have been considered. Knowledge of these scattering properties allows for the estimation of statistical properties governing large ensembles of such targets when arranged in specific configurations such as would be expected in urban centers, freeways or suburbs. The ensemble scattering behavior can, in turn, be used to predict the magnitude of the composite signal that would be observed by a downward looking microwave radiometer that is tuned to the same 24 GHz transmit frequncy as the radar.

There are a number of Earth viewing microwave radiometers currently in low Earth orbit that operate near 24 GHz. Their number is expected to increase in the near future. These instruments measure natural thermal emission that is associated with the rotational water vapor absorption line centered at 22.235 GHz. They are able to remotely sense the absolute humidity present in the lower and mid troposphere. Radio Frequency Interference (RFI) at 24 GHz originating from man made sources such as collision avoidance radars can significantly degrade the value of these radiometer measurements for weather forecasting and climate monitoring. This is true even with radars operating at extremely low transmitter power levels.

The aggregate effect of a large ensemble of automotive scattering targets will be addressed in this paper. In particular, a statistical procedure will be presented by which scattering properties of individual targets can be used to estimate the resulting level of RFI to an orbiting microwave radiometer produced by a dense population of cars arranged in typical dense configurations. These results will then be used to determine an allowable level of transmit power by the radar below which RFI should not have a significant effect on the radiometer.

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