

Y-band Radar Assessment for Indoor Navigation and Mapping

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In this paper, the application of sub-millimeter-wave imaging radars for collision avoidance and navigation of autonomous platforms in indoor environments is investigated. The polarimetric scatter phenomenology of walls and doorways are studied to aid the designing and system specifications of such radar systems. An instrumentation radar operating at 215 GHz is setup to collect backscatter data from corridors in an indoor setting. The backscattered data as a function of azimuth angle are collected while the radar is moved along the corridors. At each radar position, radar range profiles for both vertical and horizontal polarizations as a function of angle are used to form polar images. These images can be generated real time for obstacle-detection and navigation of autonomous robots. It is shown that horizontally polarized incident wave can generate higher backscatter level from smooth walls at steep angles of incidence and thus is the preferred polarization configuration for this application. Using the coordinate radar positions at each point, the polar images at each location are then co-registered in a global coordinate matrix through a "see-and-remember" algorithm to form a complete map of the interior layout. A number of image processing techniques are applied to the raw radar range profile maps to enhance the image quality and to remove the undesired effects. A linear feature extraction method based on Hough transform is used to extract the rectilinear features (walls, doors, etc.) in the complete map. Algorithms are developed to eliminate the ghost targets resulted from multi-path in the hallways.