

A 2-D antenna array, coupled with the range-migration algorithm (RMA), enables 3-D microwave imaging of people and objects in a room. The choice of antenna array configuration, microwave transceiver components, and transmit power has a significant effect on both the energy consumed by the imaging system and the quality of the resulting images. A generic microwave imaging testbed was therefore built to characterize the effect of these antenna array parameters on image quality in the 20-GHz band. The standard, the single-transmitter, and the Doppler RMAs were all compared and were found to produce good quality 3-D images with transmit power levels as low as -30 dBm, achieving an image resolution of 12.5 mm at 0.5-m range. A new figure of merit was also developed to compare how efficiently these algorithms can create an image of given quality and size. The single transmitter imaging system was the most efficient, able to generate an image signal-to-noise ratio of 1330 for each microjoule consumed per voxel in the image. These findings have led to a methodology for designing energy and cost efficient microwave imaging systems.