Non-invasive Monitoring and Tracking of Human Activities using Continuous-wave Radar

Nghia Tran and Ozlem Kilic
The Catholic University of America, Washington, DC, 20064
16tran@cua.edu, kilic@cua.edu

Contactless monitoring and tracking of human motion activities (e.g. walking, running) have attracted much attention in many application of disaster rescue service, health and sport monitoring, homeland security, urban warfare, etc. Conventional techniques employ devices attached to human body. A non-invasive monitoring approach can be ideal to monitor human activities without any human cooperation.

In this paper, we simulate a model to remotely monitor and track the daily human activities using a continuous-wave (CW) radar. This work is a continuation of our previous work on human motion detection, where human motion is modeled based on the analytical Boulic model. In this paper, human body parts are still modelled using 16 ellipsoids as in the Boulic method, but the human activities such as walking, running, limping, crawling are characterized by using a motion capture model database from CMU. These can provide a more realistic representation than those of the Boulic method.

A full-wave technique, namely Method of Moments enhanced with Multilevel Fast Multipole Algorithm (MLFMA) is used to calculate the scattered fields from the human. Mutual coupling effects between different body parts are computed accurately by using this method. Because the human is electrically large, parallelized implementation of MoM-MLFMA on a high-performance CPU-GPU computing platform is performed to accelerate the computation time.

To analyze the motion pattern of the human target, the micro-Doppler signatures from the scene are calculated by applying a time-frequency transform such as the Short-Time Fourier Transform (STFT) with a Gaussian window to the scattered fields. Simulation results for monitoring daily human activities, such as regular walking and limped walking, crawling are shown in this work. The motion characteristics of a human are analyzed using micro-Doppler signatures.