

A multistatic microwave imaging technique is presented for fast diagnosis of medical emergencies pertaining to brain injuries. The frequency-based imaging method utilizes Bessel functions to estimate the scattered power intensity inside the imaged region from measured multistatic scattered signals outside the imaged region in a quasi-real-time manner. A theory is used to prove that the relation between the scattered fields outside the imaged object (the head) and the internal scattering profile follows the first order of first type Bessel function. To reconstruct the internal scattered power intensity accurately, the average-trace subtraction method is used to remove the skin reflections and clutters. The presented algorithm is verified using realistic numerical simulations and experimental measurements, which are performed using a radar-based head imaging system that includes an antenna array containing eight elements, microwave transceiver, and switching network. To emulate different brain injuries, realistic head phantoms are utilized. The obtained results using frequency steps that meet Nyquist criterion confirm the reliability of the proposed method in the successful detection of different sizes and locations of injuries inside the head phantom in a fast and consistent way. In comparison with existing multistatic time-domain methods, the presented approach is faster and more accurate.