Measurement and Signal Processing of Radiated Fields of HPEM Sources

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Abstract— In this abstract, we present the results of measuring electric field strength of HPEM systems. Measuring chain components will be discussed. Signal processing algorithms and the ed electromagnetic fields produced by HPEM sources are shown. Two designs based on derivative and replicative sensors are presented with examples.

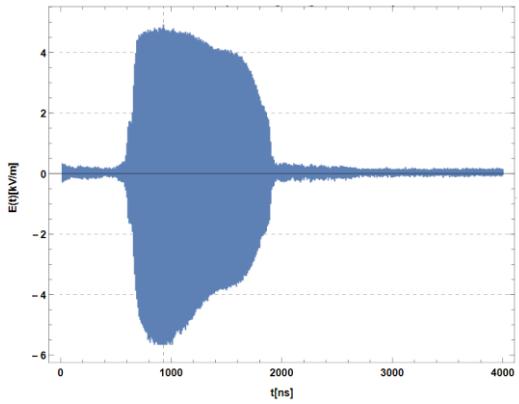
Keywords: high power electromagnetics, HPEM, d-dot, sensors.

I. INTRODUCTION

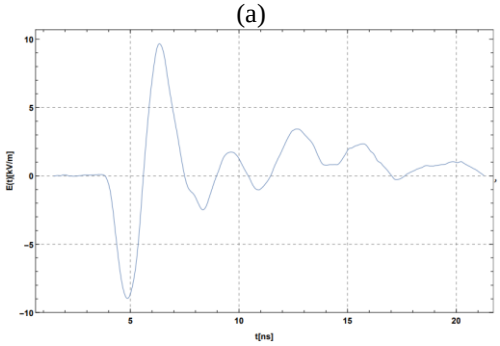
With the dynamic development of high-power electromagnetic (HPEM) sources and interest in intentional electromagnetic interference (IEMI) in the last decades, specialized measurement systems able to characterize pulsed radiated signals in the order of nanoseconds, and electric fields of hundreds of kilovolts/meter are required. Commercial solutions are currently available with specialized instruments and sensors; however, different factors in the experimental setup can affect the validity of measurements. Signal detection, synchronization, attenuation, and transmission to the recording device should be done with minimal and controlled distortion. In addition, characterization and correction factors of each element in the measuring chain must be applied [1].

Measurements systems and sensors for HPEM and IEMI should be able to measure different types of IEMI threats, including electromagnetic pulses (EMP), ultrawideband pulses (UWB), and high-power microwaves (HPM). Each type of source also presents different operation modes, including single pulse, burst, or repetitive pulses. Therefore, for proper characterization, expert interpretation and processing of the retrieved waveforms must be done to determine the actual parameters according to the nature of the signal [2].

In this presentation, we discuss in detail the measurement and signal processing of the radiated electric field of HPEM sources using two different measurement chains based on a derivative sensor (D-dot) [3] and a replicative sensor (horn antenna). The impact and limitations of the measurement components are analyzed. Also, the inherent variability of HPEM sources is observed in the experimental results, indicating that statistical analysis is required in the characterization of these kinds of signals. For illustration, Fig. 1 presents two of the signals under study, radiated by a pulsed magnetron and switched-oscillator systems [4].



(a)



(b)

Figure 1 Reconstructed E-field radiated by: (a) pulsed-magnetron system; (b) a switched-oscillator system.

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