Frequency spectrum of induced transmembrane potential and permeabilization efficacy of bipolar electric pulses

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Abstract:

In this paper a simple prediction method for the bipolar pulse cancellation effect is proposed, based on the frequency analysis of the TMP spectra of a single cell and the computed relative global spectral content up to a defined frequency threshold. We present a spectral analysis of pulses applied in experiments, and we extract the induced TMP from a microdosimetric model of the cell. The induced TMP computation is carried out on a hemispherical multi-layered cell model in the time domain.

The analysis is presented for a variety of unipolar and bipolar input signals in the nanosecond and the microsecond time scales. Our evaluations are in good agreement with experimental results for bipolar pulse cancellation of electropermeabilization-induced Ca^{2+} influx using 300 ns, 750 kV/m pulses and with other results reported in recent literature.

Keywords: bipolar electric pulses, cancellation effect, microdosimetry, Ca influx, spectral analysis.