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Variable Source Generated Sound-Fields for Electro-Hydraulic Extracorporeal Shockwave Applicators

Introduction:
Electro-Hydraulic Extracorporeal Shockwave generation results a shot-varying non-linear sound-fields which are not yet properly characterized.

Material and Method:
We have utilized a non-linear wave-propagation simulation in conjunction with experimental spark-gap measurements to predict statistical variations of generated sound-fields. These results are in turn validated with experimental point-wise field measurements in reference water baths as well as in-situ applications.

Results:
Experimental verification of simulation results for reproducible fields (i.e. Electro-magnetic and piezo) show good agreement and a significant advantage of non-linear simulation techniques over linear approximations for higher pressure waves. Electro-Hydraulic shock generation based on is shown to result in a probabilistic field distribution based on experimental spark-location distributions.

Discussion:
We provide clear evidence based on theoretical models alongside supporting experimental of the non-stationary nature of Electro-Hydraulic generated sound-fields. The indeterminate location of spark-gap induced collapsing plasma bubble results in a inter-shot variable field which applies varying energies and peak pressures throughout the treatment area. In combination with anatomic models the resulting in-silico treatment options can be numerically modeled and differences in applicator technologies estimated.

Conclusion:
We introduce a novel approach to characterize the sound-fields Electro-Hydraulic applicators. This approach is applied in estimating and comparing of treatment modalities.