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Mechanically stimulated electric signals modelled as extreme micro-current distributions

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The existence of mechanically stimulated electric signals, either by Pressure (PSC) or by Bending (BSC) has been proved to be related to the mechanical handling of rock specimens in previous laboratory work. The corresponding analysis has been focusing on specific signal properties, such as the relaxation time, the delay of MSES peak occurrence, the MSES peak signal level and the evolution of the peaks in cyclic loading. Each of these parameters was extracted by analyzing a specific part of the signal.

In this work we propose a different approach in the problem by considering the recorded signal as a microcurrent superposition over the cross sectional plane of measuring electrodes. The micro MSES signals superposition forms the total observed MSES signal distribution over time, which is quite asymmetric. We address the problem of fitting such MSES graphs by using Extreme Value distributions, which can produce a pronounced asymmetry by nested exponentials and a single peak oriented fitting result, based on the peak value of the PSC signal. Specifically, the Generalised Extreme Value Distribution is simplified to the Gumbel distribution, which Probability Density Function is used for modeling. The fitting performance of Extreme Value distribution was verified against recorded data from rock specimens and the correlation coefficient is over 0.97 for all fitted signals. Concluding we have to point out that the Generalised Extreme Value distribution was selected for the modelling of the MSES peak signal, as the most suitable to model the largest value of a set of measurements. The fitting results were satisfactory for all instances of the signal, as well as the fitting converged regardless of the amplitude of the MSES signal.

Therefore the Generalised Extreme Value distribution could be suitable for macroscopic modelling of peaks of the MSES signal as it can model both the MSES peak and the corresponding relaxation in a unified way.