Classification of acoustic emission for granular media and microseismic events.

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Acoustic emission is a widespread method of non-destructive testing of natural objects and engineering structures. Acoustic emission data allow us to investigate the mechanics of the formation of macro cracks and determine the patterns of their spatial localization. The detected pulses during destruction can be classified according to generation type using parameters describing their wave form –RA value (a calculated feature derived from rise time divided by

peak amplitude), and averaged frequency AF (a calculated feature obtained from count divided by duration). The paper presents a new approach to the classification of acoustic emission pulses, obtained as a result of experiments on shear deformation of loaded granular material. The new pulse typing tool is a modification of the RA/AF algorithm and is based on clustering by the k-means method for parameters describing the waveform of the selected AE pulses: RA-value, averaged frequency AF and the waveform index WI. The additional parameter WI characterizes the envelope of the AE pulse and is defined as the ratio of the pulse rise time to the attenuation time. The application of the method makes it possible to distinguish ensembles of AE pulses, which are characterized by different scaling ratios and different initiation mechanisms. The algorithm was tested on mine microseismicity data, where it also showed high informativeness. Among the selected clusters, there are differences in the average value of the reduced seismic energy ES/M0 in the ratio between the scalar seismic moment M0 and the corner frequency f0 of the source, which indicates a different magnitude of stress relief. Thus, the proposed method of analysis can be used for both laboratory and in-situ data.