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Detection of the nonlinearity evolution in concrete samples subject to quasi-static loadings

Paola Antonaci[a], Pietro Bocca[b], Caterina Bruno[b], Antonio Gliozzi[a], Davide Masera[b] and Marco Scalerandi[a]
[a]Politecnico di Torino, Corso Duca degli Abruzzi 24, 10129 Torino, Italy
[b]Politecnico di Torino, Structural Engineering Department, 10129 Torino, Italy

The signature of nonlinearity in the elastic response of a specimen to an impingent ultrasonic wave is usually determined through Fourier analysis, which provides low amplitude signals, often below noise level. We suggest here an alternative, based on the amplitude dependence of the response of the system. Our procedure is conceptually simple and easy to implement. In addition, it keeps simultaneously into account the nonlinear signature effects on phases, amplitudes and frequencies of the response. The procedure is described and used to analyse the variation of the nonlinearity in a concrete bar subject to quasi-static loadings of increasing amplitude. The sensitivity of the approach allows to distinguish the compaction phase (up to a load of 30% of the rupture loading) from a microdamage progression (up to a load of 60%) and the pre-rupture phases.