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**Fast and Slow Dynamics in Damaged Materials : Correlation to  
Acoustic Emission**

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Results are reported of the study of anomalous nonlinear fast dynamics (FD) and slow dynamics (SD) in damaged solids. Experimental observations characterizing FD and SD may be used to detect and eventually characterize induced damage of structural components. Here, we analyze the evolution of the non-linear dynamic behaviour of two polymer-based composites of different reinforcing elements as Sheet Moulding Compound (SMC) and Polymer Concrete (PC) as a function of their gradual damage. More particularly, non-linear FD and SD parameters (time and frequency shift) have been found to be very sensitive to damage creation and evolution for both materials. Besides, acoustic emission monitoring was performed and allowed to calculate the elastic energy released by SMC and PC at every damage stage. Interesting logarithm-like evolution of the followed non-linear parameters as a function of the calculated energy is found. A classification of the collected acoustic emission signals is proposed to understand the contribution of the different damage mechanisms to the evolution of the non-linear behaviour.