Grid nano-indentation as full-field measurements

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The use of grid nano-indentation as a full-field measurement tool to investigate the properties of heterogeneous materials is described. Contrarily to the reported approaches which rely on statistical analysis, the mechanical properties fields are analyzed herein relying on a topological description of the sample. The spatial convolution function is approached using Hertz contact theory, and the obtained convolution kernel is used to retrieve the mechanical properties of the different phases. This approach is exemplified on results obtained at very low contact force (and thus very high spatial resolution) on a composite material sample made of micrometer-sized fibers in a polymeric matrix.
It particularly allows to approach the structure of the sample at the finer scale, and revealed herein a very steep modulus gradient for the matrix material in a thin ring around the fiber. Such a description could be obtained by a successive enrichment, which is driven by the residual of the projection onto the convolution kernel. This analysis method is thus expected to provide some useful insight into interfacial regions of composite materials.