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Locating a small change in a multiple scattering environment (LOCADIF)

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This article presents an imaging technique to locate a weak perturbation in a multiple scattering environment. We derive a formula to predict the spatio-temporal decorrelation of diffuse coda waves induced by an extra-scatterer. Locating this new defect is then formulated as an inverse problem which is solved by a maximum likelihood approach. Using elastic waves in the 100-350 KHz frequency band, we show that the position of a millimetric hole drilled in a heterogeneous concrete sample can be retrieved with a precision of a few cm. We illustrate the robustness of the method and define an optimal time of propagation that depends on the geometry of the acquisition and the diffusion constant of the medium. Potential application to seismic coda waves includes volcano monitoring and eruption prediction.