# Two-scale finite element simulations for UT inspection of micro-structured materials in CIVA

**Edouard Demaldent[1], Nicolas Leymarie[1], Vincent Dorval[1], Alexandre Imperiale[1], Thibaud Fortuna[1]**

[1]Department of Non Destructive Testing, CEA LIST, France

Ultrasonic testing (UT) of highly heterogeneous structures is an important issue for many industrial applications in civil engineering for concrete inspection as well as in nuclear and oil & gas, where it applies to cast steels and weld joints. In these materials, performance is limited by the phenomenon of multiple wave scattering at the microstructure scale. In this context, the use of effective simulation tools is particularly useful both for improving interpretation of UT and for optimizing or demonstrating the performance of inspections. However, the scales of heterogeneity to be taken into account are often smaller than fractions of a tenth of a wavelength. In 3D simulations, it is therefore difficult, if not impossible, to combine computational performances with the refinement of the modelled interactions. To meet this challenge, CEA is developing an original approach based on two applications of the finite element (FE) method implemented in CIVA. The first application uses micro-scale heterogeneous material data on small representative elemental volumes (REVs) to feed a second code dedicated to macro-scale with effective medium characteristic. This second code relies on a high-order finite element model that is very efficient at the scale of the inspected industrial component. In this communication we present the main features of these FE tools and illustrate their performances on different application cases for welded parts and concrete.