

Finite Element Modeling of Transducers using the ATILA++ Code

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ATILA is a finite element software package generally used to model devices including active materials such as electrostrictive, magnetostrictive and piezoelectric materials. The solver allows to combine fluid-structure with thermo-electro-mechanical calculations.

In the first part of this project, a nonlinear constitutive relationship with electro-mechanical material parameters varying with the temperature, together with a temperature field calculation from the heat generated by material losses, has been implemented in ATILA++. It has been shown that the influence of the working temperature in the constitutive relationship can significantly change the expected behavior of transducers. In a second part, following experimental results showing the influence of stress on the behavior of single crystal materials, a new constitutive relationship and incorporating this influence was developed and implemented in ATILA++.

New results are presented showing that, although incomplete, methods used in this project for modeling single crystal materials are relevant in most of circumstances. Also, in addition to the pseudo-nonlinear harmonic solver present in ATILA++, a new general purpose non-linear transient solver is implemented to model structures incorporating single crystal materials subjected to arbitrary loading conditions.

Moreover, a new method to couple FEM and BEM calculations is developed. It allows to model the structural response and acoustic radiation of transducers in a fluid. Some results are presented.