

AceGen/AceFEM system and its foundation on automatic differentiation

Toni Jelušič, toni.jelusic@c3m.si

Centre for Computational Continuum Mechanics, Ljubljana, Slovenia

Automatic differentiation (AD) is used to avoid the problem of expression growth that is associated with symbolic differentiation. With automatic differentiation we use intermediate variables to generate simplified expressions during code generation [1]. The important thing to note about automatic differentiation is that the classical way of optimizing expressions in computer algebra systems is searching for common subexpressions *after* all the formulae have been derived and *before* the generation of the numerical code, which in turn leads to inefficient code.

An extension of the approach based on AD is the possibility to generate codes in multiple different languages like C or FORTRAN and for multiple environments like AceFEM, Abaqus or Ansys [2]. The theory that combines automatic differentiation, simultaneous optimization of expressions with automatic selection and introduction of appropriate intermediate variables in generation of numerical code is the foundation of the AceGen system. AceGen is used for multi-language and multi-environment code generation. It is intended for use in derivation of formulas for nonlinear finite element analysis. More details about this system can be found in [3].

The code generated with AceGen can be used in AceFEM, which is the Mathematica finite element environment, with more details about the system in [4].

References

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