CADFEM Consulting

Drop Test Simulation of Electronic Products

Efficient Combination of Explicit and Implicit Solution Schemes

Your Contact Person:

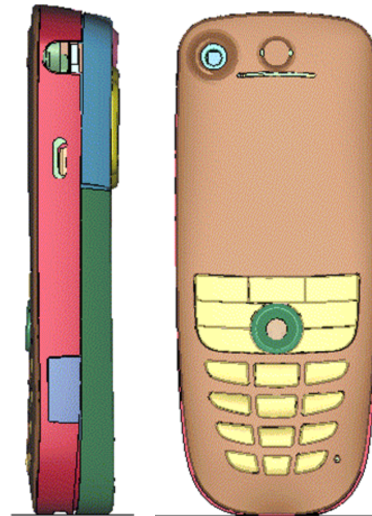
Dipl.-Ing. (FH) Thomas Iberer
Tel. +49-(0)8092-7005-50
E-Mail tiberer@cadfem.de

Task

The so called drop test is one of the most severe load cases for testing the structural integrity of electronic handheld structures. Typical failure modes can be:

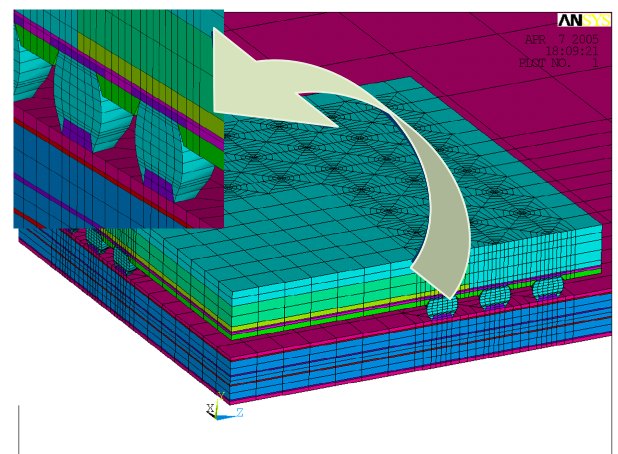
- Loss of connection between plastic cover parts
- Cracks within the plastic cover parts
- Damage within electronic parts at the PCB
- Failure at the solder joints between electronic parts and PCB

The simulation of such a test scenario by means of FEM is widely accepted and established in industry. LS-DYNA® and ANSYS® are approved software packages for simulations in this field. Typically different mathematical algorithms for the transient solution of an impact loading are implemented in those codes. Normally highly transient analyses are solved efficiently by explicit codes like LS-DYNA. However, due to the time step criterion and the related mesh size requirements for explicit methods, ANSYS as an implicit code is necessary to resolve local stress fields.



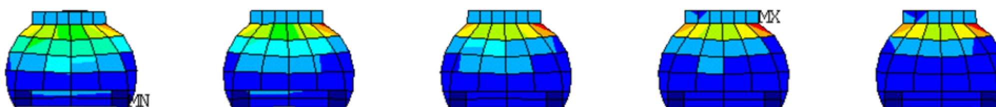
Drop test simulation of a fully equipped mobile phone by means of FEM (Courtesy of Motorola, Italy)

The typical failure modes shown above can be classified into different scales – the macro scale considering global structural parts and the micro scale with possible failure mechanisms within the electronic parts. Because of the different constraints for the different integration methods it isn't either reasonable to use a pure explicit nor to use a pure implicit solver to calculate the structural response both for the global model and the very detailed electronic components. The solution of this contradiction is a combination of both the explicit method for simulation of the global structure with a very coarse description of the critical parts and the implicit method for simulation of a submodel with the specific components. In this case the load time histories of the global analysis are used simply as the boundary condition for the submodel.



Detailed discretization of electronic components (here BGA at the PCB)

This coupling allows the combination of the advantages of explicit and implicit time integration without caring about non convergence or too small time steps. Short simulation times and very detailed results for further assessment of the structure are possible.



Detailed discretization of electronic components (here BGA at the PCB)