Industry Sector	RTD Thematic Area	Date
Consumer Goods		

Use of Finite Element Analyses in mobile phones design process

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Summary

Finite Element Analyses are increasingly being used in the design process of small electronics, as mobile phones, from scratch to prototype testing.

Characteristic of product development

- Short development time, time to market factor is extremely important
- Traditionally, development of small electronics have been supported by (rapid-) prototyping. Testing with trial-and-error and very fast design updates
- Plastic components for small electronics have not been as well optimized as other industries.

Analyses

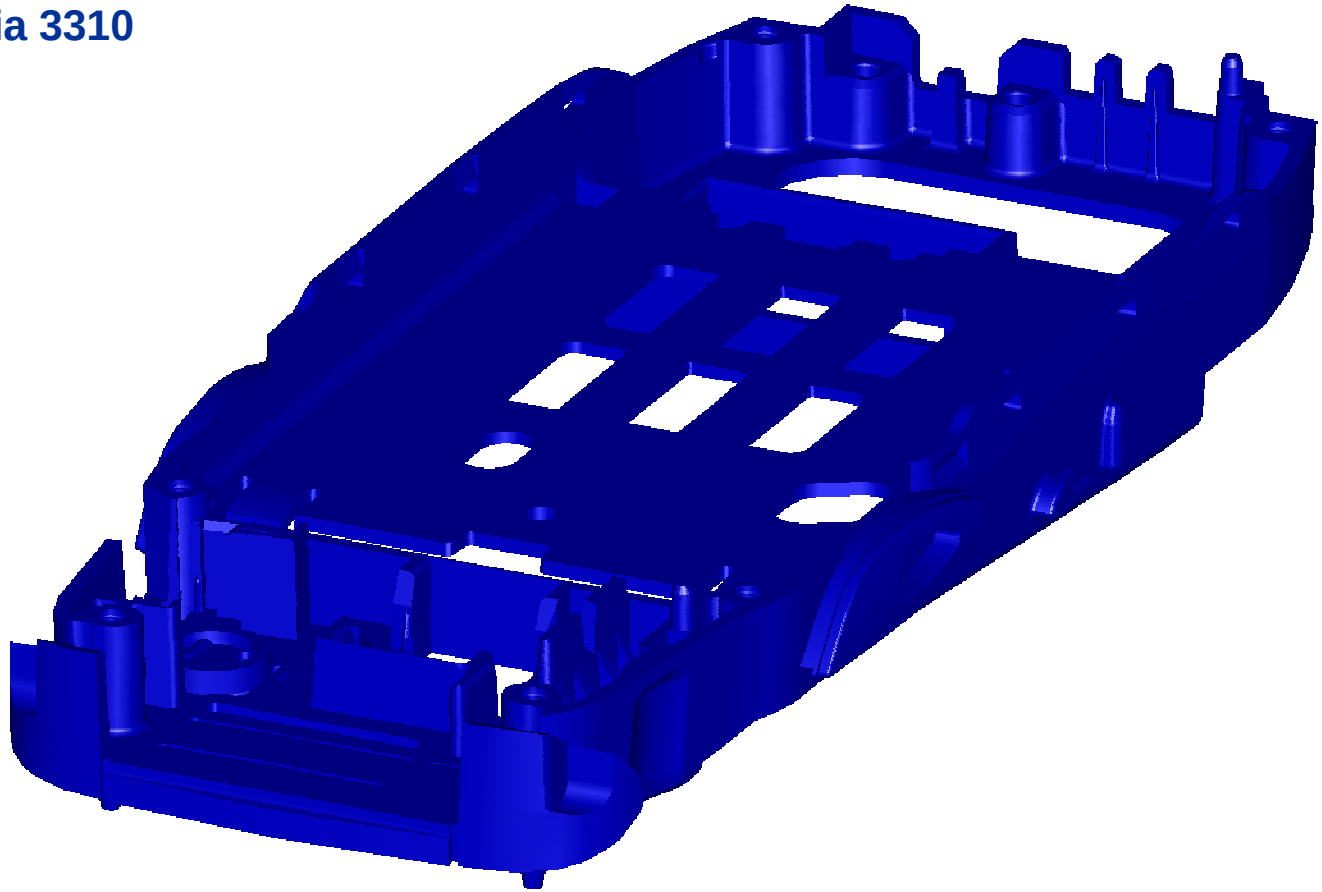
- The use of Finite Element technology has now been very well adopted in small electronics industry, and in following is divided into:
  - Static analyses
  - Dynamic analyses
  - Packaging level analyses
  - Moldflow analyses
  - Others

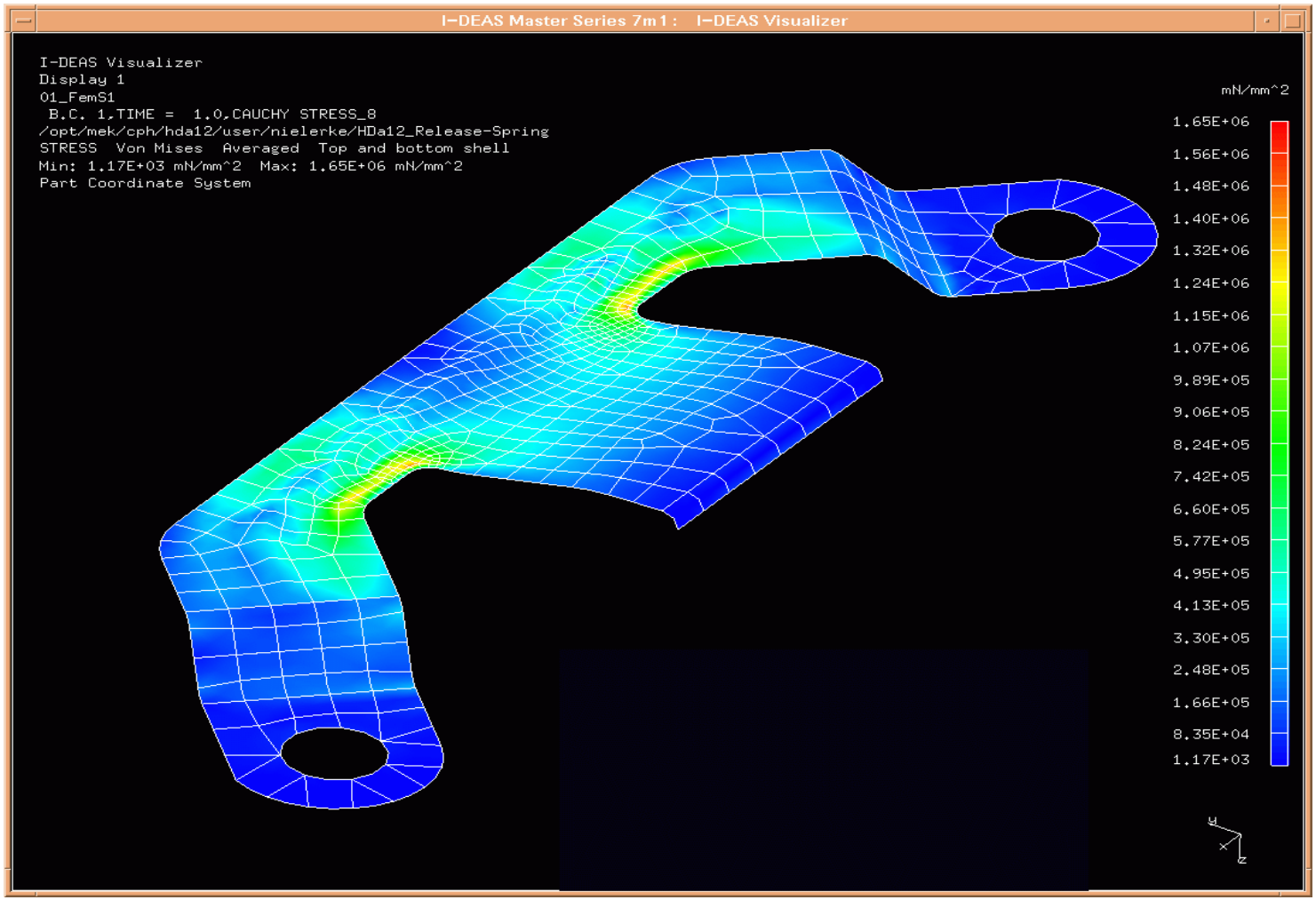
Types of analyses

Static analyses on single part level

- Static analyses on single part level plays an important role in design stage where updates and revisions happen daily and is used for:
  - Optimization of single parts design by comparing different modifications.
  - Very complex geometries are made possible by use of injection molding process
    - Many parts like speakers, buttons, PWB's etc causes many gaps, fillets and other features.
    - Preprocessing is an inportant and very time consuming task due to part preparation and simplification
  - Material models are typical simple linear, if purpose of analysis is of simple comparative nature
  - Creep or nonlinear material models in more advanced cases

D-cover part of Nokia 3310

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STRESS Von Mises Averaged Top and bottom shell
Min: 1.17E+03 mN/mm^2 Max: 1.65E+06 mN/mm^2
Part Coordinate System
mN/mm^2
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1.24E+06
1.15E+06
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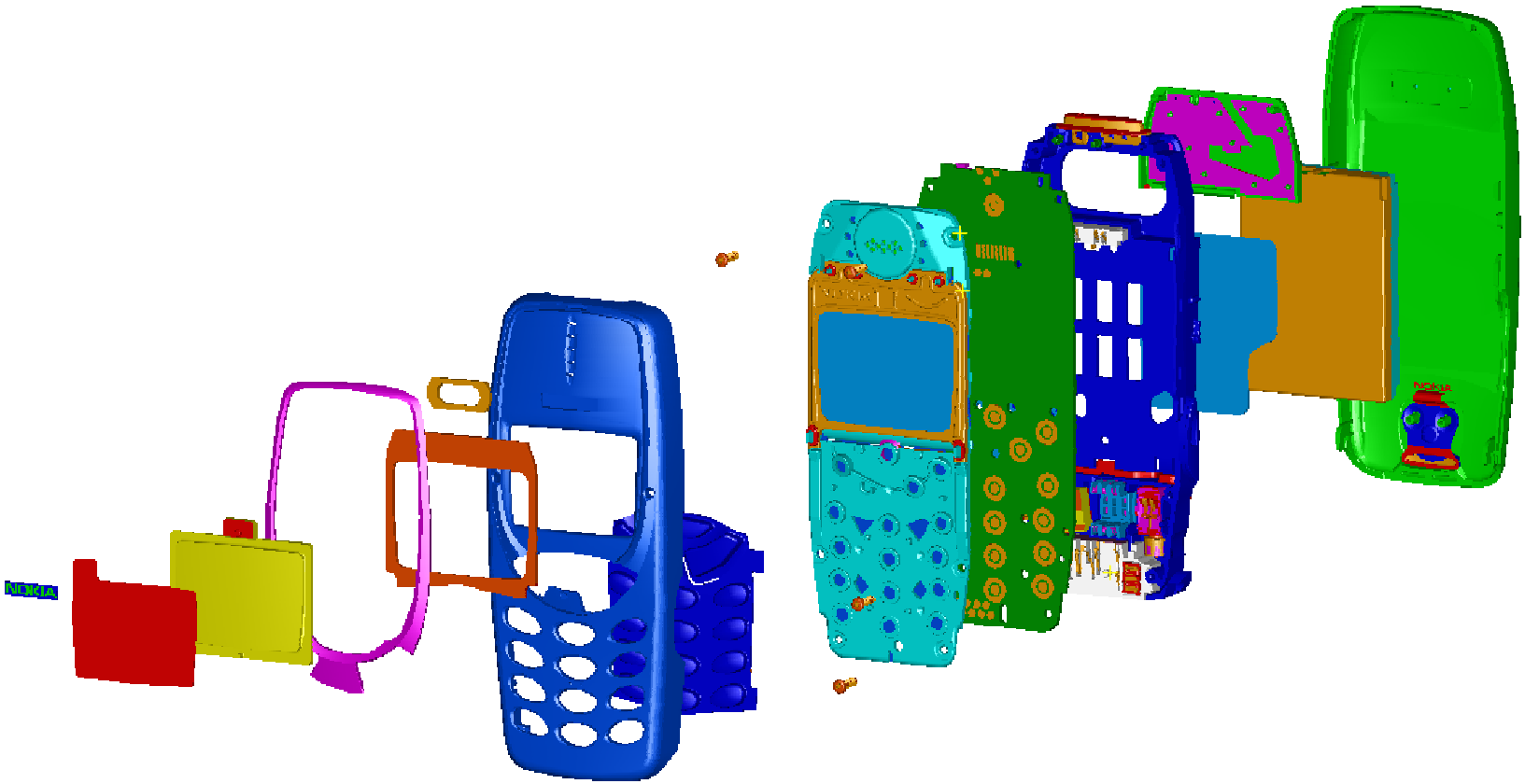
4.13E+05
3.30E+05
2.48E+05
1.66E+05
8.35E+04
1.17E+03

Types of analyses

Static analyses on assembly part level

- Mobile phone assembly:
  - Many parts, can be more than 20
    - Combination of different materials as plastic and metal
    - Can include rubber material
  - Parts can be snapped or screwed together
    - Can be advanced solve if geometric and material nonlinearity is included.
    - Many contacts



Types of analyses

Dynamic analyses

- Impact resistance is a major requirement and is increasingly included in analyses:
  - Linear dynamic analyses
    - Modal analyses
      - » Single part analyses
      - » Assemblies
    - Modal testing
      - » Stiffness
      - » Frequencies
      - » Damping
  - Nonlinear Dynamic analyses
    - Typical explicit methods
    - Contact
    - Simplified material models, subject for further investigation

Types of analyses

Packaging level

- Extremely detailed models
  - on detailed solder level
  - sub modelling: Global to local models
- Advanced material models

- FE analyses on packaging level are performed for
  - Thermal loading
  - Mechanical loading
  - Themo-mechanical loading
- Thermal, mechanical and thermo-mechanical analyses in this field is of very high interest.

Types of analyses

Heat transfer analyses

- Increasing need for consideration of heat transfer analysis
  - More and larger components gives more convection
  - Miniturization is a challenge

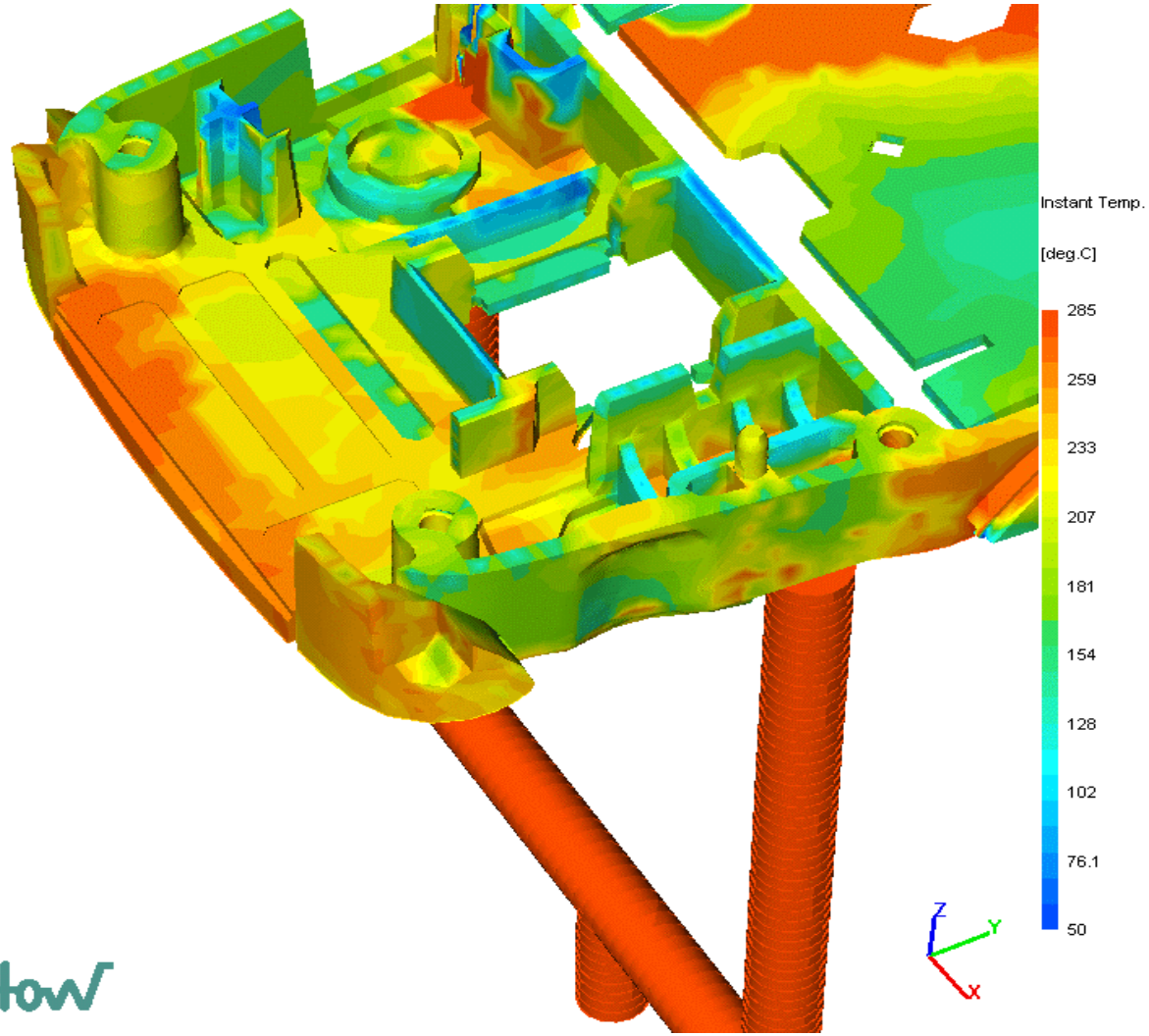
Moldflow analyses

- Complex part geometry is very demanding to injection molding manufacturing
  - Moldflow analyses on single part level for
    - Design optimization
    - Gate positioning
    - Welding line positioning, for strength consideration
    - After pressure to avoid sinkmarks

Optical Simulations

- Hard to perform, specialist area

Moldflow analysis



moldflow

Use of Finite Element analyses in the future

- More integrated analyses
  - Increasing use of integrated ease of use tools
  - Use of FE at design engineer level
  - Optimization
- More advanced models
  - More nonlinear dynamic models
  - Rate dependent material models in dynamic analyses
  - Coupling of global and local models, eg packaging
- Coupling of analyses
  - Qualities from moldflow analyses into FE analyses

Research and development needs

- Material models:
  - There is a great need for clarifying strain rate dependencies, ultimate (tensile) stress at different strain rates, fatigue machanisms and parameters and others for many polymer materials
  - Must be a need for other companies in consumer goods industry

- Lifetime prediction and optimization in Electronic Packaging under thermal, mechanical and thermomechanical loading
- Multiphysics