

Simulation is more than Software®

## Make David out of Goliath



## Model Reduction inside ANSYS

### CADFEM ANSYS Extension for system analysis of 3D-FEM models

#### As large as necessary

The simulation of components as 3D-FEM models is well established in the modern development process. Among other things, these models are used in engineering at the system level. Presently, the simultaneous simulations, using multiple solution codes for various engineering disciplines, are integrated into a single dynamic analysis.

One hurdle in this process is the level of detail of the 3D-FEM models, which is often extremely high, and the large amount of data that results. This massive data severely impedes the ability to have a common geometry for different simulations. Model Reduction inside ANSYS (previously MOR for ANSYS, where MOR stands for Model Order Reduction) supports development engineers in their efforts to solve this bottleneck.

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# Model Reduction inside ANSYS

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### As quickly as possible

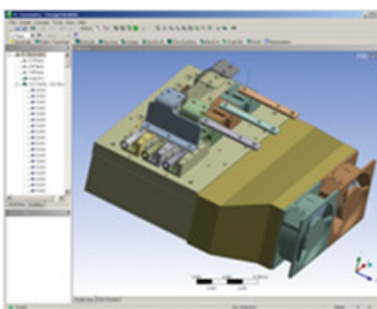
The algorithms contained in Model Reduction inside ANSYS systematically translate the high-dimensional 3D-FEM model into a size-optimized model with equivalent characteristics. The degree of simplification is prescribed by the user on the basis of an acceptable approximation error. Model Reduction inside ANSYS can be used for any model from ANSYS Mechanical, especially for the piezoelectric and thermo-mechanical models.

The process of model simplification with Model Reduction inside ANSYS is much faster than a dynamic simulation using the original data. This means that CADFEM ANSYS Extension is suited to be a quick solver of transient and harmonic simulations. The reduced matrix system can be read directly into commonly-used tools for system simulation such as ANSYS Simplorer and MATLAB/Simulink. The simplified model can also be written in the VHDL-AMS or Spice languages.

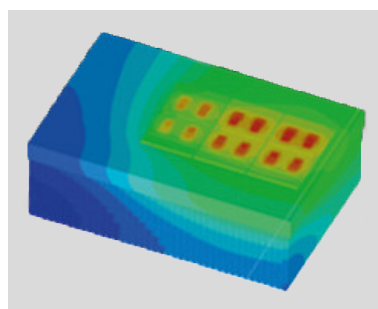
### IGBT converter example

The example of an electrothermic simulation of an IGBT converter illustrates the operating principles of Model Reduction inside ANSYS. The electrical model of the IGBT is dependent on temperature values, which must be determined in a system level simulation. The IGBT converter contains three DCPs with six IGBTs and six diodes, which are represented as 12 heat sources.

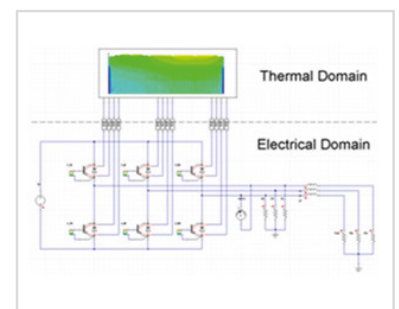
The 3D-FEM model in ANSYS describes an accurate temperature distribution and also incorporates thermal overlaps. Model Reduction inside ANSYS generates corresponding small matrices which can be used for electrothermic simulation in ANSYS Simplorer.



Physics & Geometry



System of  $n$  ODEs



Reduced System of  $r \ll n$  ODEs

Simplified model of an IGBT converter

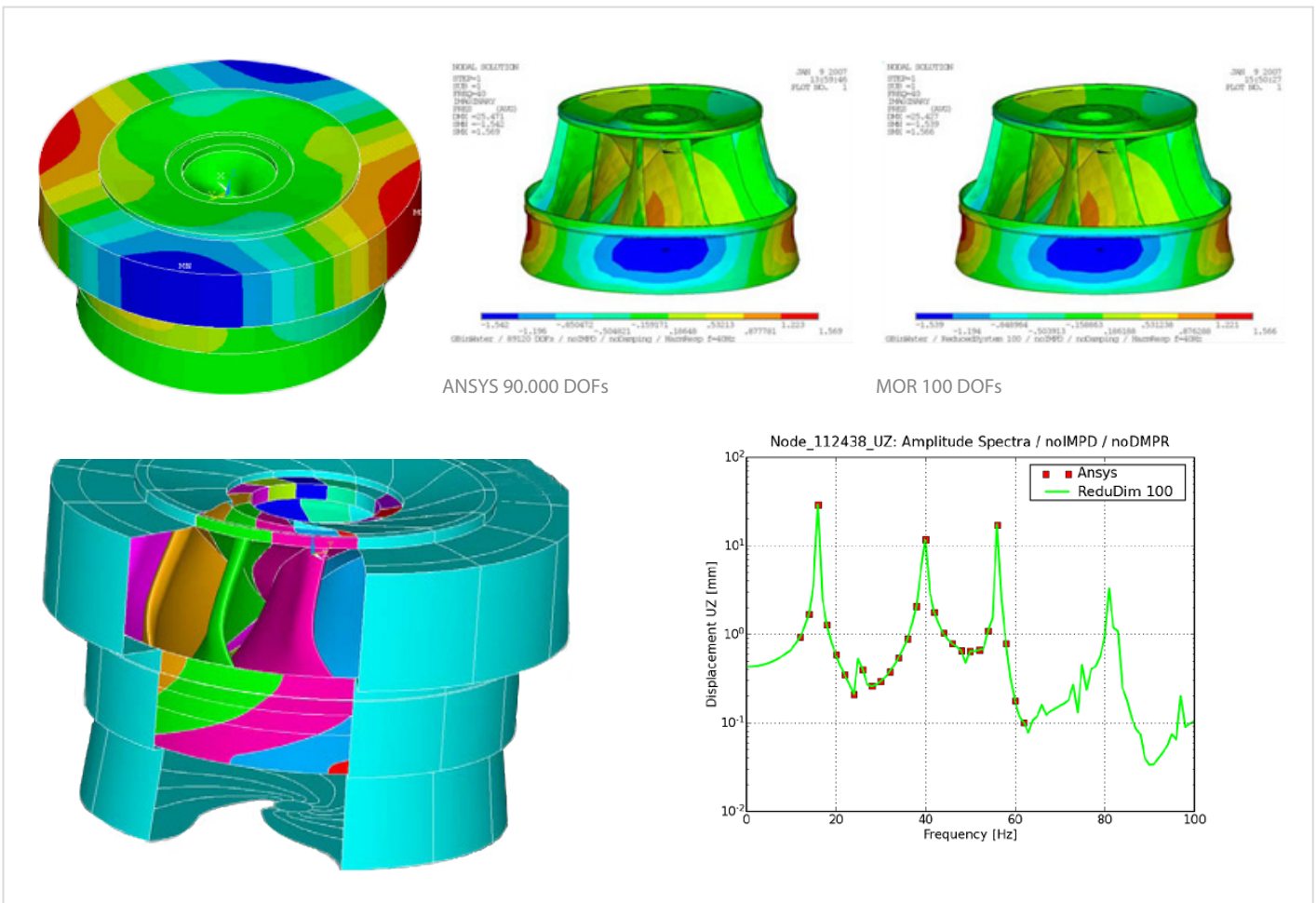
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### Voith turbine rotor example

Voith Siemens Hydro Power Generation use simulations to analyze the dynamic stimulation of a turbine rotor caused by rotating pressure fields that arise from the rotor-stator interaction. This type of analysis is suited to take advantage of the model reduction for time savings, because highly detailed geometry is not required. The original ANSYS geometry can

be reduced to 1% of its original size with Model Reduction inside ANSYS while retaining the essential information. The total time required for the model simplification and subsequent harmonic analysis is much less than that required for a comparable harmonic analysis with the original model.



Solution of the FSI task: dynamic stimulation of a turbine rotor caused by rotating pressure fields that arise from the rotor-stator interaction.

# Model Reduction inside ANSYS

## CADFEM ANSYS Extension for system analysis of 3D-FEM models

### Technical information

System requirements: ANSYS Workbench, Version 16 or later

Further examples and detailed information about Model Reduction inside ANSYS: [www.modelreduction.com](http://www.modelreduction.com)

[www.cadfem.de/extensions](http://www.cadfem.de/extensions)

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