Motivation

ANSYS
- Quite a popular Finite Element simulation package.
- Convenient graphical modelling.
- Widespread use in the engineering.
- However the time for transient and harmonic simulation is unacceptably long.

Model Order Reduction
- Reduction of simulation time is essential for design optimization and system-level simulation.
- Models of small dimension can be simulated in very short time.
- Moment matching via the Arnoldi process allows us to reduce the dimension of the original system by many orders of magnitude.
- The model reduction process is automatic as it is based on the formal procedure.

mor4ansys

Step 1: Reads system matrices from ANSYS
- First order ODEs $C\dot{x}(t) + Kx(t) = Bu(t)$
- Second order ODEs $M\ddot{x}(t) + C\dot{x}(t) + Kx(t) = Bu(t)$
- Web-interface to upload ANSYS emat files.

Step 2: Performs model reduction
- Match Coefficients of Taylor Expansion of the transfer function $H(s) = L^{-1}(s^2M + sC + K)^{-1}B$.
- The Arnoldi process finds a projection matrix $x = V'z + e$.
- Projection produces the reduced model $V'MVz(t) + V'CVz(t) + V'KVz(t) = V'Bu(t)$
- No user intervention is required.
- The dimension of the original model is up to 500 000.
- In many cases, the dimension of the reduced model up to 30 is already enough.

Step 3: Write a reduced model
- Currently simulation with the reduced model is done in Mathematica.
- Can be written in Hardware Description Language.

Compact Electro-thermal Model of Motorola’s Semiconductor Device with Multiple Heat Sources

Compact Mechanical Model of Imego’s Butterfly Gyroscope

More Information
- mor4ansys, also papers and preprints http://www.imtek.uni-freiburg.de/simulation/mor4ansys/
- Model reduction for Micropyros online http://www.imtek.uni-freiburg.de/simulation/pyros/
- Benchmarks for model reduction http://www.imtek.uni-freiburg.de/simulation/benchmark/

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