



Computational applied dynamics

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Professorship of Applied Mechanics and Dynamics

Faculty of Mechanical Engineering

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Master Advanced Manufacturing:

Specialisation 'Computational Manufacturing Engineering'



Learning dynamical simulation from scratch

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Applied dynamical
simulation

Analysing a
physical system

Choosing a
mechanical model

Mathematical
formulations

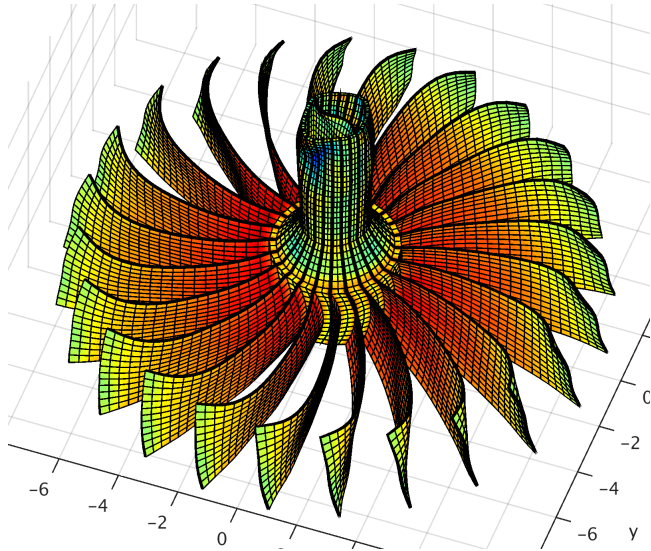
Deriving analytical
solutions

Implementation
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Approximation and
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Conclusions

Analysing the properties of the physical system





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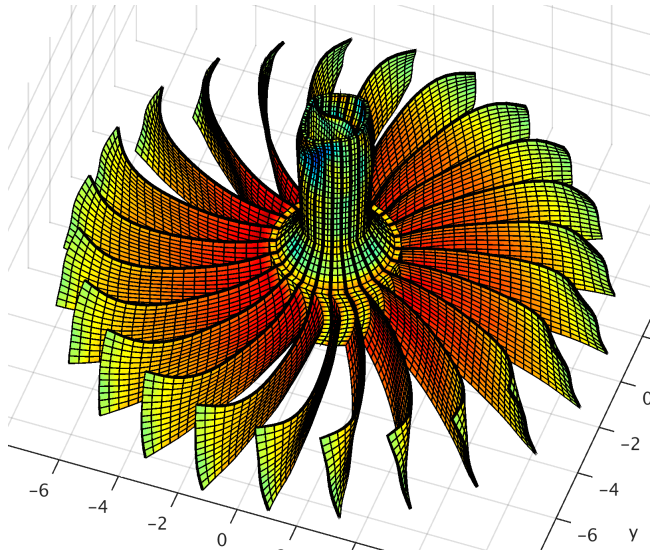
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Creating a physical model which is simple as possible



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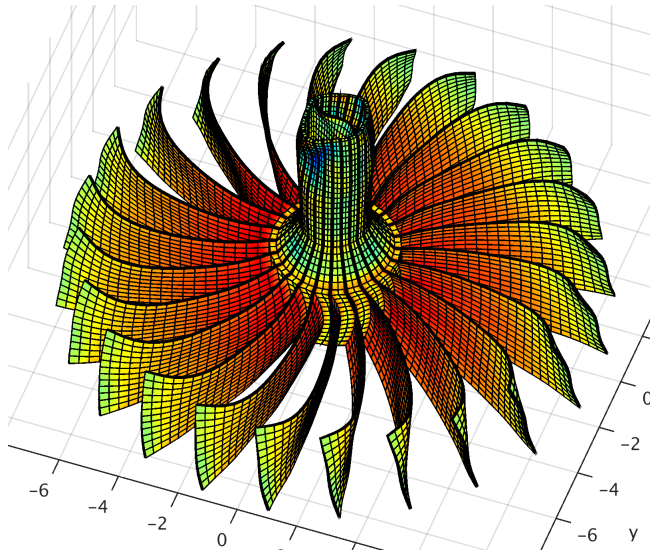
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Thinking about an appropriate mathematical formulation



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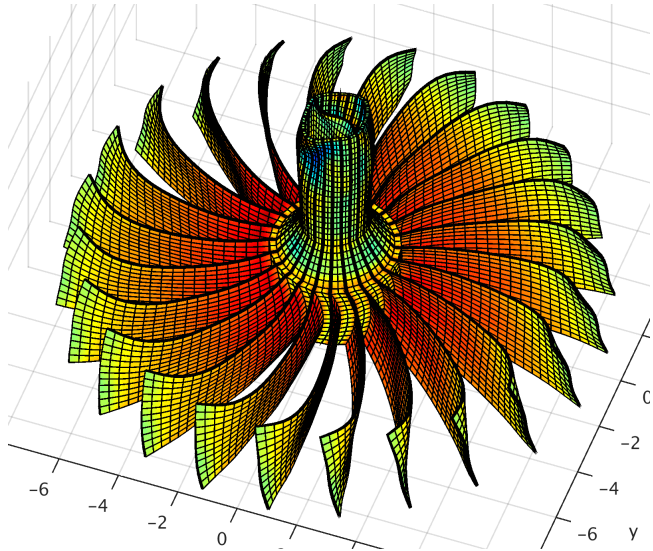
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Deriving first an analytical solution of a special case





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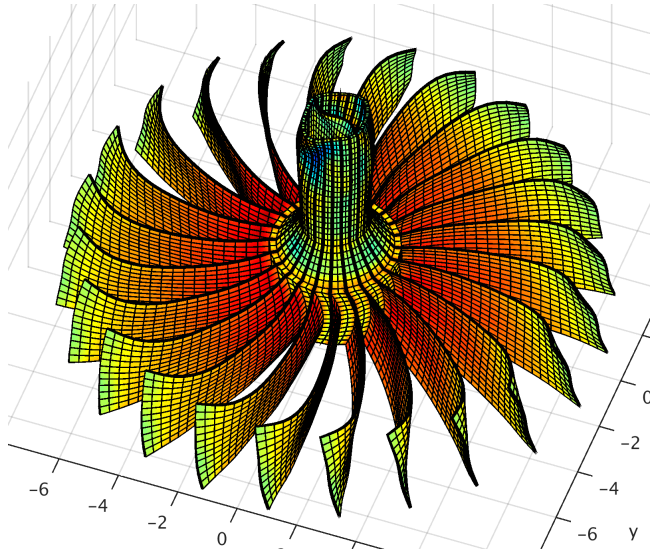
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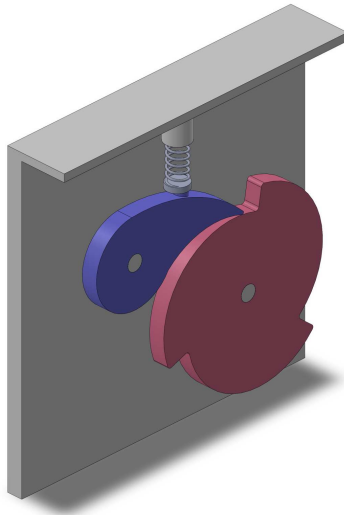
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Which motions are possible in the system?



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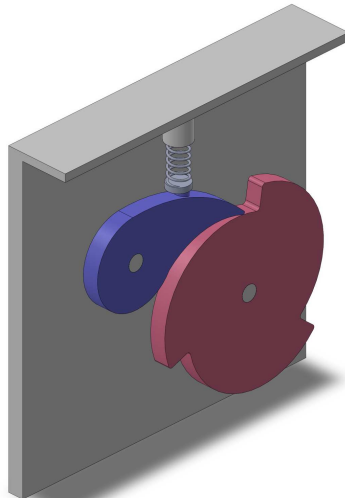
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Which deformations are possible?



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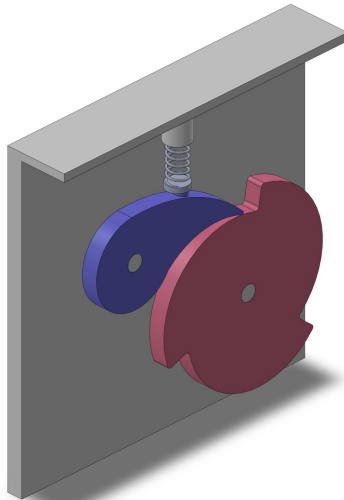
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Which material behaviour has to be considered?



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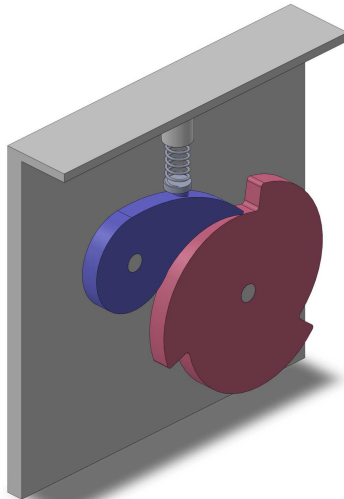
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Which total energy behaviour is present?



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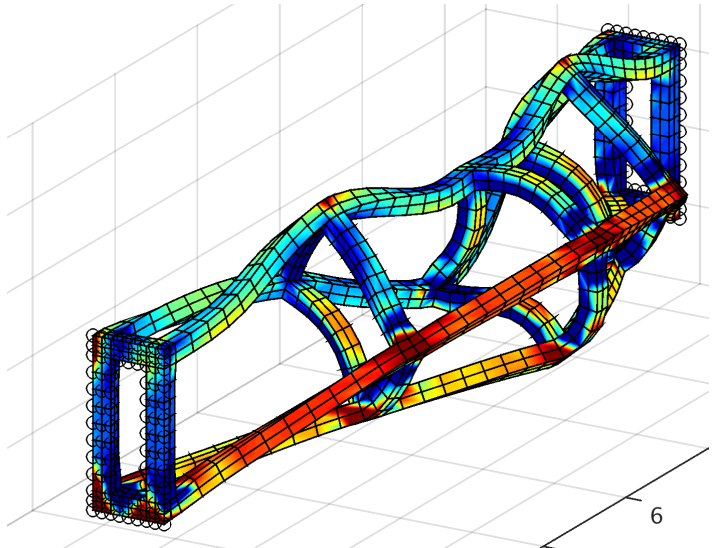
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Multibody dynamics: mass point, rigid body, spring, damper



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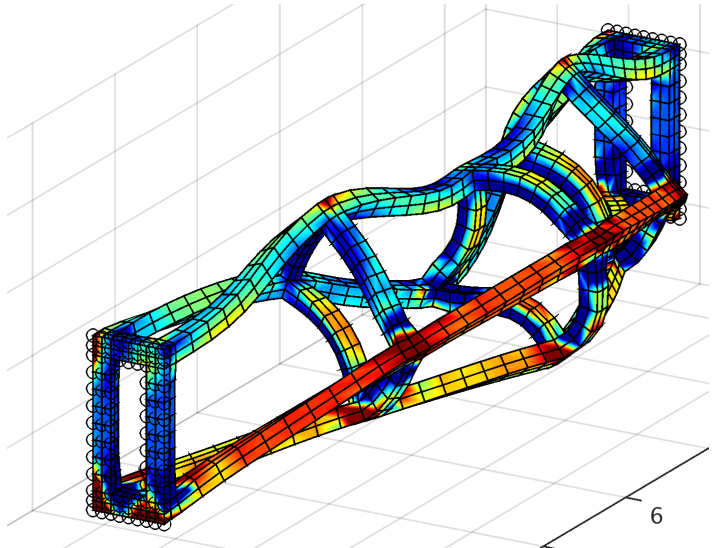
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Structural dynamics: string and rod, beam, plate, shell



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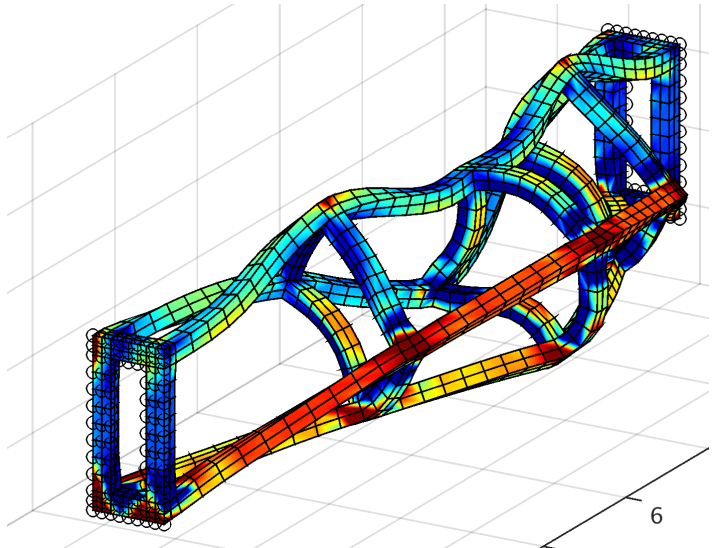
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Continuum dynamics: for any deformation and motion





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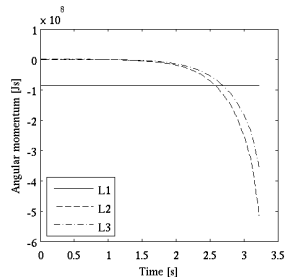
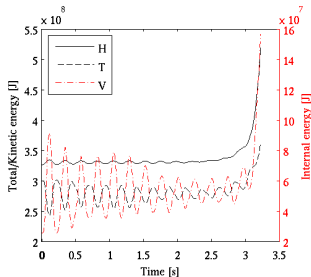
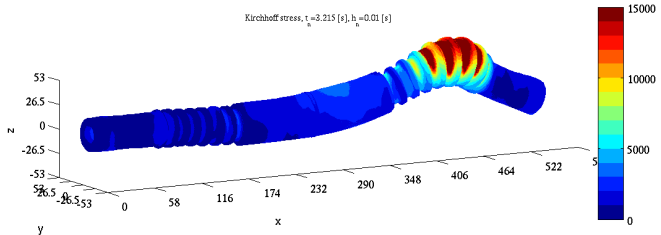
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Formulation should represent the system energy behaviour



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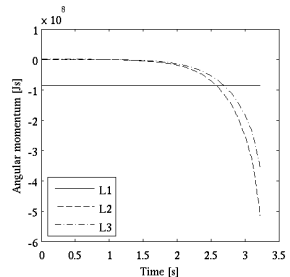
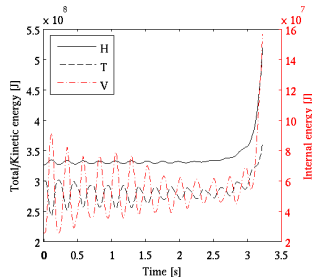
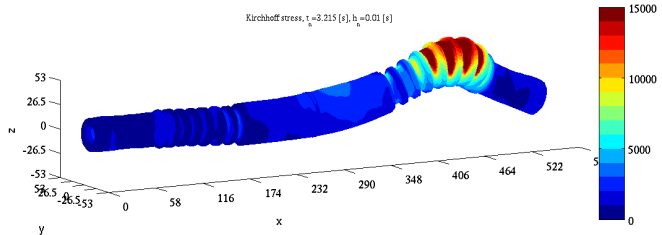
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Formulation can be derived by axioms of dynamics





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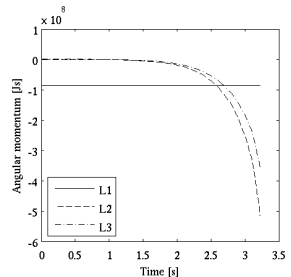
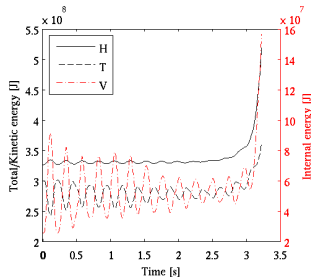
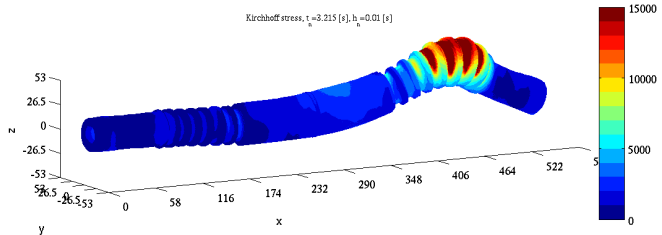
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Equations should be solvable: analytically or numerically



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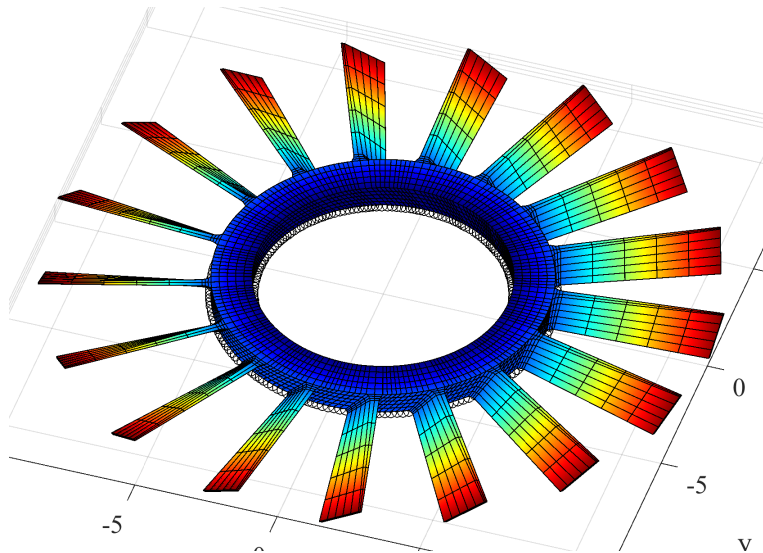
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Physical as well as mathematical model can be checked



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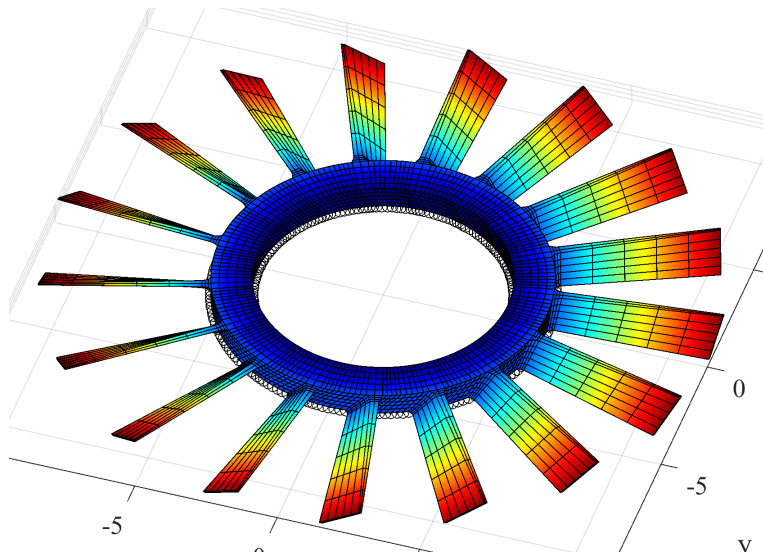
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The chosen approximation method can be checked





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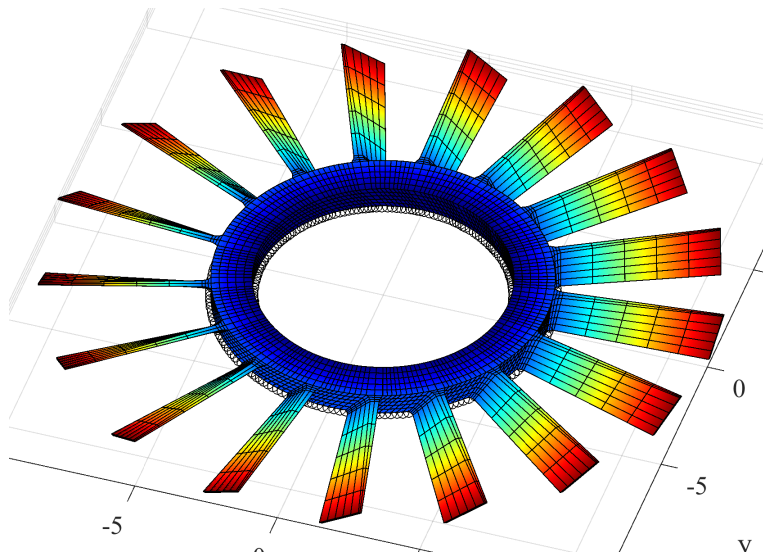
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The implementation itself can be checked





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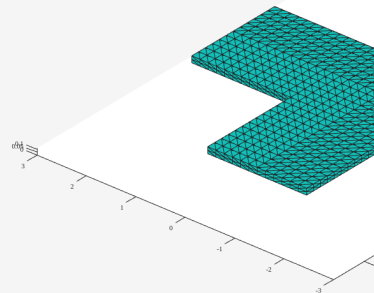
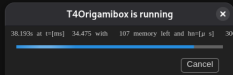
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Decision between ease-of-use and execution speed

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Decision between matrix or component computing

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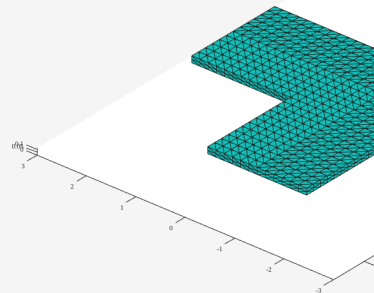
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Decision about available libraries of solver

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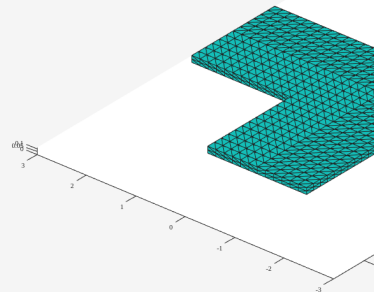
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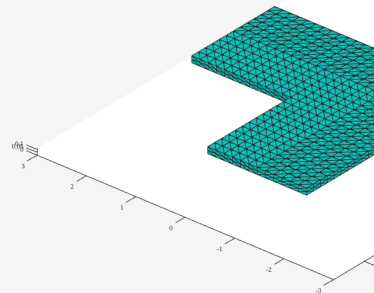
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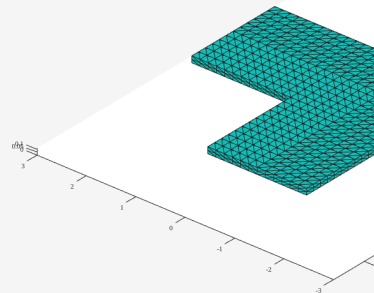
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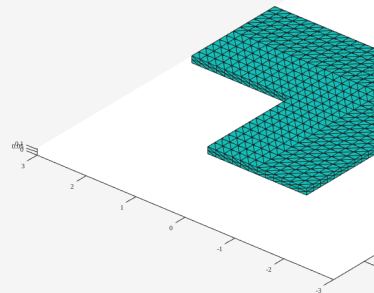
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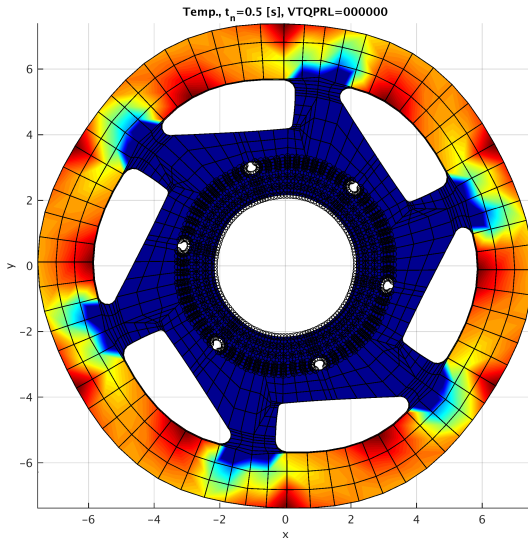
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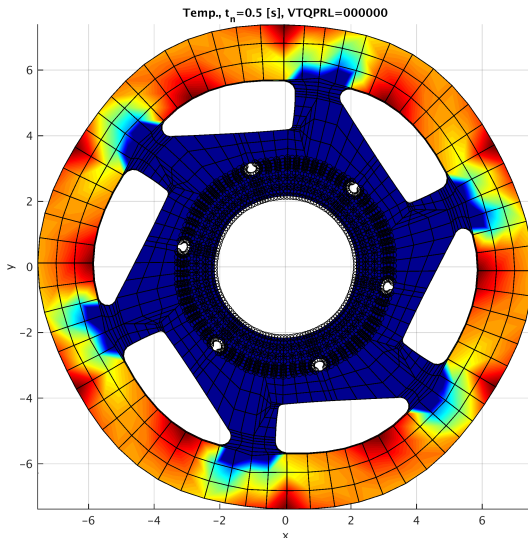
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Numerical simulations are based on differential equations



Differential equations are approximated in space and time



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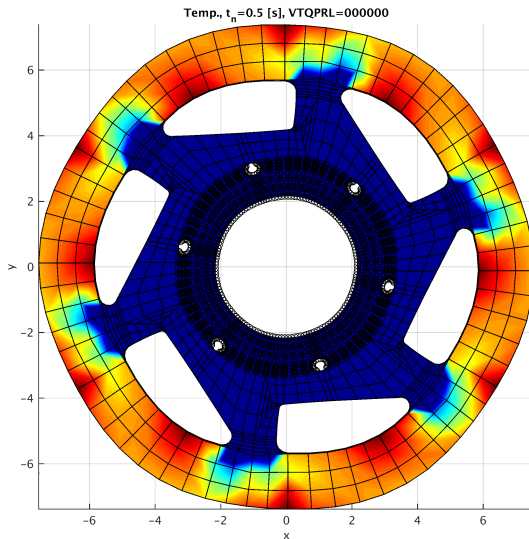
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Both approximations can be performed by finite elements



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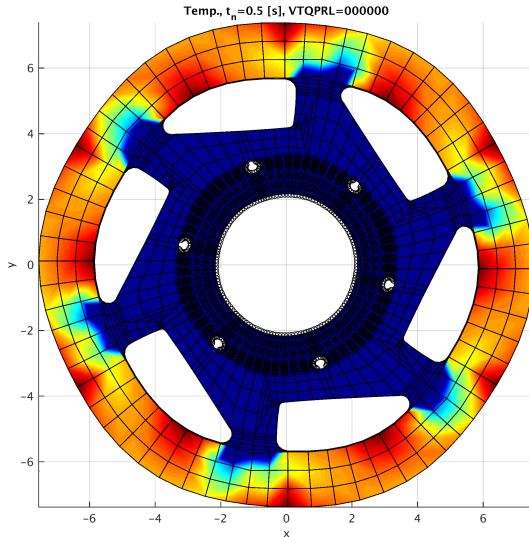
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These approximations are based on polynomials or splines



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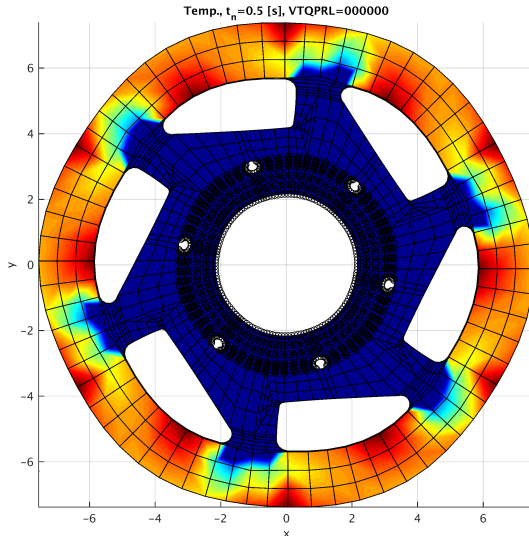
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Integration and differentiation is also approximated



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