UNIVERSITÀ DEGLI STUDI DI NAPOLI
FEDERICO II

SOFA Framework – Class III

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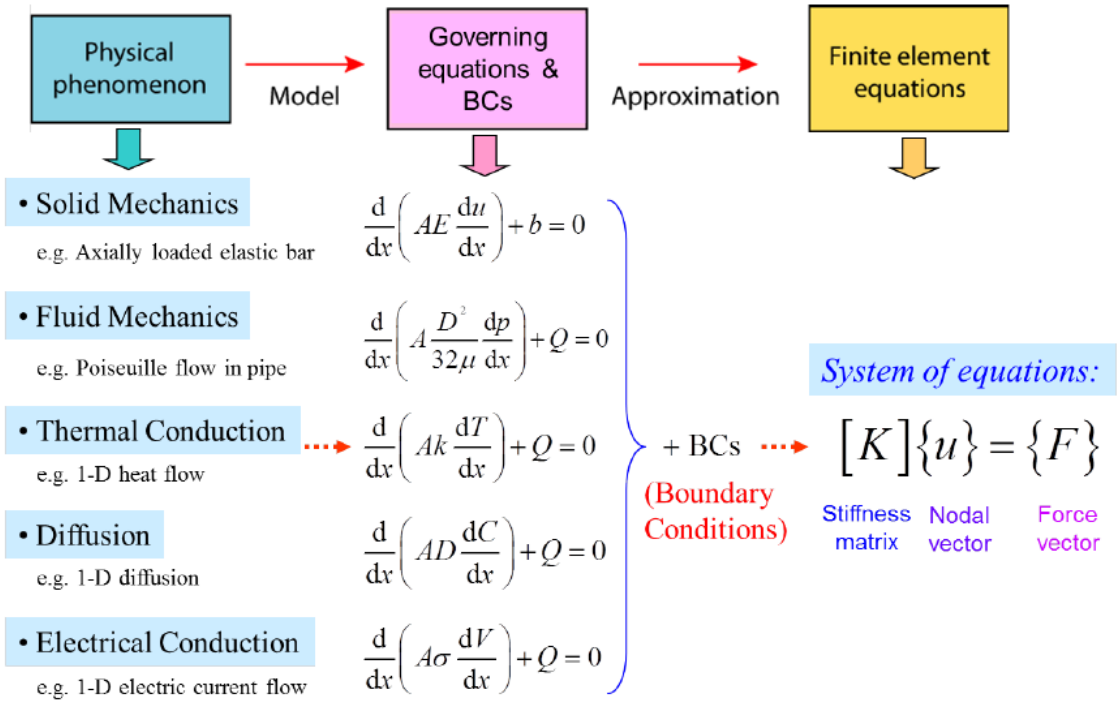
SOFA – Finite Element Modelling

- The finite element method (FEM) is a numerical technique for solving a wide range of complex physical phenomena, particularly those exhibiting geometrical and material non-linearities (such as those that are often encountered in the physical and engineering sciences).



SOFA – Finite Element Modelling

$$[K]\{u\} = \{F\}$$
$$\{u\} = [K]^{-1}\{F\}$$

[K] = Properties
{u} = Behaviour
{F} = Action

	Properties	Behaviour	Action
Elastic	Stiffness	Deformations	Strength
Thermal	Conductivity	Temperature	Heat
Fluid dynamics	Viscosity	Speed	Volumetric strength

SOFA – Mapping

- SOFA supports several DataTypes corresponding to the DOFs:

- ***Vec1f or Vec1d:*** 1 DOF per node is used. Vec1f denotes vectors of float and Vec1d denotes the use of doubles.

- ***Vec2f or Vec2d:*** 2 DOFs per node are used. For instance, this can be used for cardiac electrophysiology.

- ***Vec3f or Vec3d:*** 3 DOFs per node are used. For instance, this can be used for mechanics.

- ***Vec6f or Vec6d:*** 6 DOFs per node are used. For instance, this can be used for beam simulations (3 translations and 3 rotations).

SOFA – Mapping

- ***Rigid3d:*** this DataType corresponds to 7 DOFs per node, this can be used to simulate rigid bodies (3 positions and 1 quaternion).

- In the MechanicalObject, each of these state vectors can be accessed using (scattered) state vectors, called multi-vectors or MultiVec.

```
<Node name="root" dt="0.01" >
    <DefaultAnimationLoop />
<MechanicalObject template="Vec3d" name="myDOFs"
    position="0 0 0"/>
</Node>
```

SOFA – Mapping

- Vec3d → Rigid3 Rigid Mapping
- Vec3d → Vec3d Barycentric Mapping
- Rigid3 → Vec3d Barycentric Mapping
- Rigid3 → Rigid3 Rigid Mapping

SOFA – Example III- Liver