Lecture :- Basic Principle
Ali Munther Mustafa

A finite-element based program for simulating unlimited multiphysics and single-physics applications. It incorporates easy-to-use application interfaces, complete control over meshing, and powerful solvers.
COMSOL MULTIPHYSICS

Lecture :- Basic Principle

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* COMSOL Mulitphysics is a software for calculation of linear and nonlinear problems by means of partial differential equations (PDGLen) by the method of finite elements.
* Unlimited MULTIPHYSICS for the simultaneous modeling of systems in 1D, 2D or 3D
* Automatic and adaptive mesh generation with detailed and interactive control capabilities for grid sizes

* Interface:
  
  CAD: (SolidWorks, Pro/E, Parasolid, ACIS, IGES,...)
  
  Simulatoren: Spice, Simulink
  
  Sprachen: Matlab, C, Fortran, Java
**STRUCTURAL MECHANICS MODULE**

Performs classical stress-strain analyses with full multiphysics capabilities. Comprises non-linear material models, large deformation, and contact abilities; all able to be freely coupled to other physics.

**HEAT TRANSFER MODULE**

Consists of advanced application modes for the analysis of heat transfer by conduction, convection, and radiation. Specific for industrial applications such as electronics cooling and process engineering.

**CAD IMPORT MODULE**

Facilitates the translation of most industry-standard CAD formats for the purpose of importing and manipulating designs and geometries in the COBOL Multiphysics environment.

**CHEMICAL ENGINEERING MODULE**

Analyzes CFD and mass and energy balances coupled to chemical reaction kinetics. Incorporates a large number of modeling interfaces for the field of transport phenomena.

**AC/DC MODULE**

Simulates electrical components and devices that depend on electrostatics, magnetostatics, and electromagnetic quasi-statics applications, particularly coupled to other physics. Consists of specific interfaces for rotating machinery applications and SPICE circuit list import.

**EARTH SCIENCE MODULE**

Models single and coupled processes for geological and environmental phenomena particularly based around subsurface flow. Ideal for porous media flow coupled to other physics such as poroelasticity applications.

**RF MODULE**

Characterizes electromagnetic fields, currents, and waves for RF, microwave, optical and other high-frequency devices. Allows for extensive post-processing such as S-parameter computations and far-field analyses.
MATERIAL LIBRARY

- Extensible library of over 2500 materials
- 20,000 properties: elastic, thermal, and many more
- Piecewise analytical functions
- Temperature-dependent data
- Built-in optional smoothing of discontinuous functions

Installing and running COMSOL Multiphysics
After accepting the license agreement, provide the required licensing information by pointing to your license.dat file that has been provided by COMSOL.

Review the platform selection

Select platforms to install:
- [ ] Linux (64-bit)
- [ ] Linux (64-bit support, AMD64/EM64T)
- [ ] Mac OS X (Intel 32-bit)
- [ ] Mac OS X (Intel 64-bit support)
Choose the required features and the installation path. Cluster Components must be included, and is checked by default in the Full installation Quick Selection.

After any additional specifications are done, click Install.
Structural Analysis in the COMSOL Environment

- Analysis types available in COMSOL Multiphysics:
  - Static
  - Transient
  - Frequency-response
  - Eigenfrequency (modal analysis)
  - Damped eigenfrequency
  - Elastoplastic
  - Thermal stress
  - Viscoelastic
  - Creep
  - Hyperelastic
  - Poroelastic
  - Contact
- and more including Multiphysics analysis: Flow, Electromagnetics, Heat, Piezo
CAD Interoperability

- Bidirectional Associative Parametric Interfaces with SolidWorks® and Autodesk® Inventor®

CAD Repair and Defeaturing Tools

- Parasolid-based CAD Geometry Repair and Defeating tools ease meshing of large CAD parts and assemblies
CAD Repair Tools – for easier meshing

- Remove small faces

Before

After

CAD Defeaturing – for easier meshing

- Remove holes

Before

After
CAD Defeaturing – for easier meshing
Remove fillets (rounded corners)

Before

After

Material Library
- More than 2500 materials
Material Library Example: Elasticity (E) vs. Temperature (T) of Ti-Ni shape memory alloy

Material Library

Detailed references
Create your Own Material and Material Functions

Some Structural Analysis Examples in the power point