External Materials in AC/DC

Quick Start Guide

COMSOL

Overview

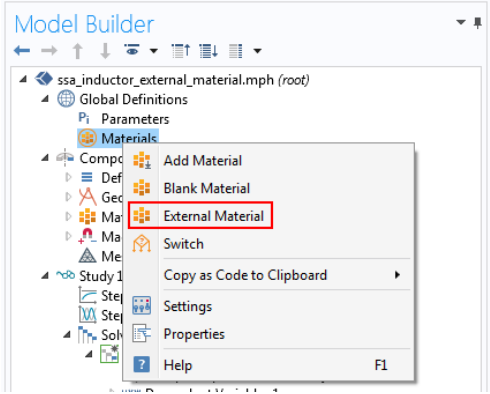
- A new way to specify user-defined material models included in COMSOL Multiphysics version 5.2.
- You can now access external material functions, written in C code, which have been compiled into a shared library.
- By writing a gateway function in C code, you can also use material functions written in another programming language.
- This makes it possible to program your own material models and distribute such models as add-ons.
- Available with the
  - AC/DC Module (2D magnetics available without the AC/DC Module)
  - Structural Mechanics Module
  - MEMS modules
- Examples include a model file, a source code file, and a shared library compiled and linked for 64-bit Windows
- Running the models on Linux™ and OS X requires additional compilation and linking

External Materials

- The external material model is implemented as a C-function with a certain calling convention, compiled and linked to create dynamically linked libraries that can be called from a material node in the Model Builder at runtime.
- For details, see the section *Working with External Materials* in the *COMSOL Multiphysics Reference Manual*.

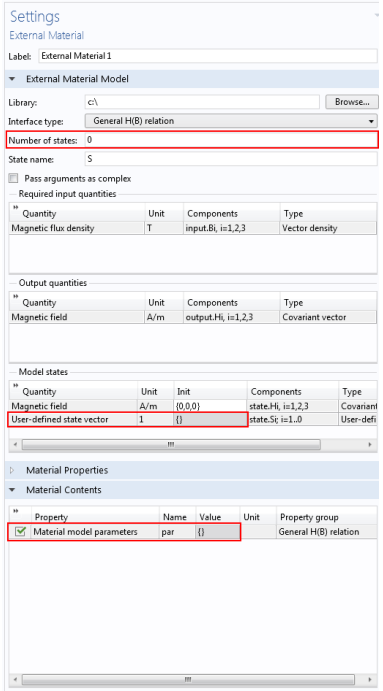
Add External Material

- Under Global Definitions, right click Materials and add External Material
- In the Settings window, browse to the path of the library file compiled for your OS (e.g. `.dll` for Windows)



Set Up The Material

- Choose the appropriate **Interface type**:
  - **General H(B) Relation** for Magnetic Fields, Magnetic and Electric Fields, and Rotating Machinery, Magnetic.
  - **General B(H) Relation** for Magnetic Fields, No Currents and Magnetic Field Formulation.
- Specify the **Number of states** that the external library requires (for the example library, zero)
- In the **Model states** table, enter the initialization vector for the states (for the example library, an empty vector: { })
- In the table in **Material Contents** section, specify the **Material models parameters** required by the external library (for the example library, no parameters are needed, so specify the empty vector: { })



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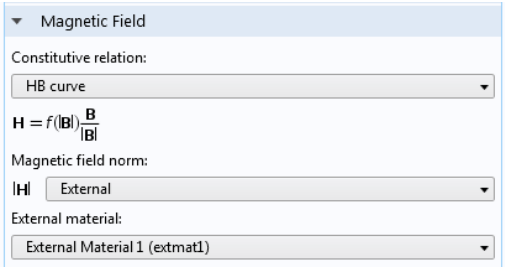
Use The Material

- Go to the domain feature of the physics (Ampère's Law, Magnetic Flux Conservation...)
- In the **Magnetic Field** section, select **HB curve** as the **Constitutive relation**
- Select **External** as the **Magnetic field norm** specification
- Select the External material previously added



Security Settings

- Use of external libraries is disabled by default for security reasons
- In the Preferences window, under Security, check the Allow external processes and libraries check box
- If external libraries are not allowed, an error occurs while solving