THE HERMES PREPROCESSOR FOR FEM2D

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Abstract
This chapter describes several properties of the Hermes preprocessor that must be taken into account when defining an iron model. The basic elements of the language as keypoints, lines, areas and meshing are treated.

1 General rules

- The lines are ended by a semicolon.
- To comment a line insert a -- before it. Comments can also be added at the end of lines.
- Variables can be up to 100 characters long.

2 Definition of scalar values. Parameters.

- Scalar variables cannot start by kp, ln, ar, or BH
- All arithmetic operations plus the functions Sin, Cos, Asin, Acos, Sqrt, Tan are allowed in scalar expressions.
- Design variables are defined with the prefix dv and its value is given by Roxie if they are defined as design variables there too.

3 Definition of keypoints.

- Keypoints are represented with variables starting with kp
- Possible operation with keypoints: sum, product by an scalar, subtraction.
- Defined from the scalar expressions with the operators:
  Cartesian coordinates [xcoor, ycoor]
  Polar coordinates [radius, angle]
- It is possible to access the coordinates of a keypoint as : kp1.x and kp1.y
- The EllipKp(a,b,phi) returns a keypoint belonging to an ellipse of semi-axis a and b and with an angle of phi with respect to the x axis.

4 Definition of lines and arcs.

- Line variables start always with ln.
- Lines are defined with 2 keypoints and the mesh distribution in the line
- Arcs are defined by the start and end keypoint and the radius of curvature. Give the start and end points in clockwise sense.
- Elliptic arcs are defined with 3 keypoints. Start, end and middle point. To help obtaining the points one function is provided for calculating a keypoint from the two half axis and the azimuthal position of the point in the ellipse.
  \[ kp1 = \text{EllipKp}(a, b, \text{angle}) \]
  \[ ln1 = \text{Ellipse}(\text{kpStart}, \text{kpEnd}, \text{kpMiddle}) \]
5 **Definition of macroelements.**

- The macroelement variables start always by *ar*
- Macroelements are defined by four lines and a material.
  
  \[ ar1 = \text{Area}(ln1,ln2,ln3,ln4,BHiron1) \]
- The order of the lines is anticlockwise.
- If no material is given, the macroelement is supposed to have \( \mu_r = 1 \)
- All the existing macroelements can be mirrored around the x or y axis with the *Mirrorx* or *Mirrory* commands.

6 **Boundary conditions.**

- Only to boundary conditions exist. If no boundary condition is specified the induction will be perpendicular to the boundary line.
- The condition of induction parallel to the boundary line is specified as *SetB(ln1)*

7 **Meshing.**

- The number of elements touching a given line is specified as *Lmesh(ln1)*. The number of elements is transmitted to all the lines that must have a coherent number of elements with the specified line.