OpenParEM2D

<u>O</u>pen <u>Par</u>allel <u>E</u>lectro<u>m</u>agnetic <u>2D</u> - A free, open-source electromagnetic simulator for 2D waveguides and transmission lines.
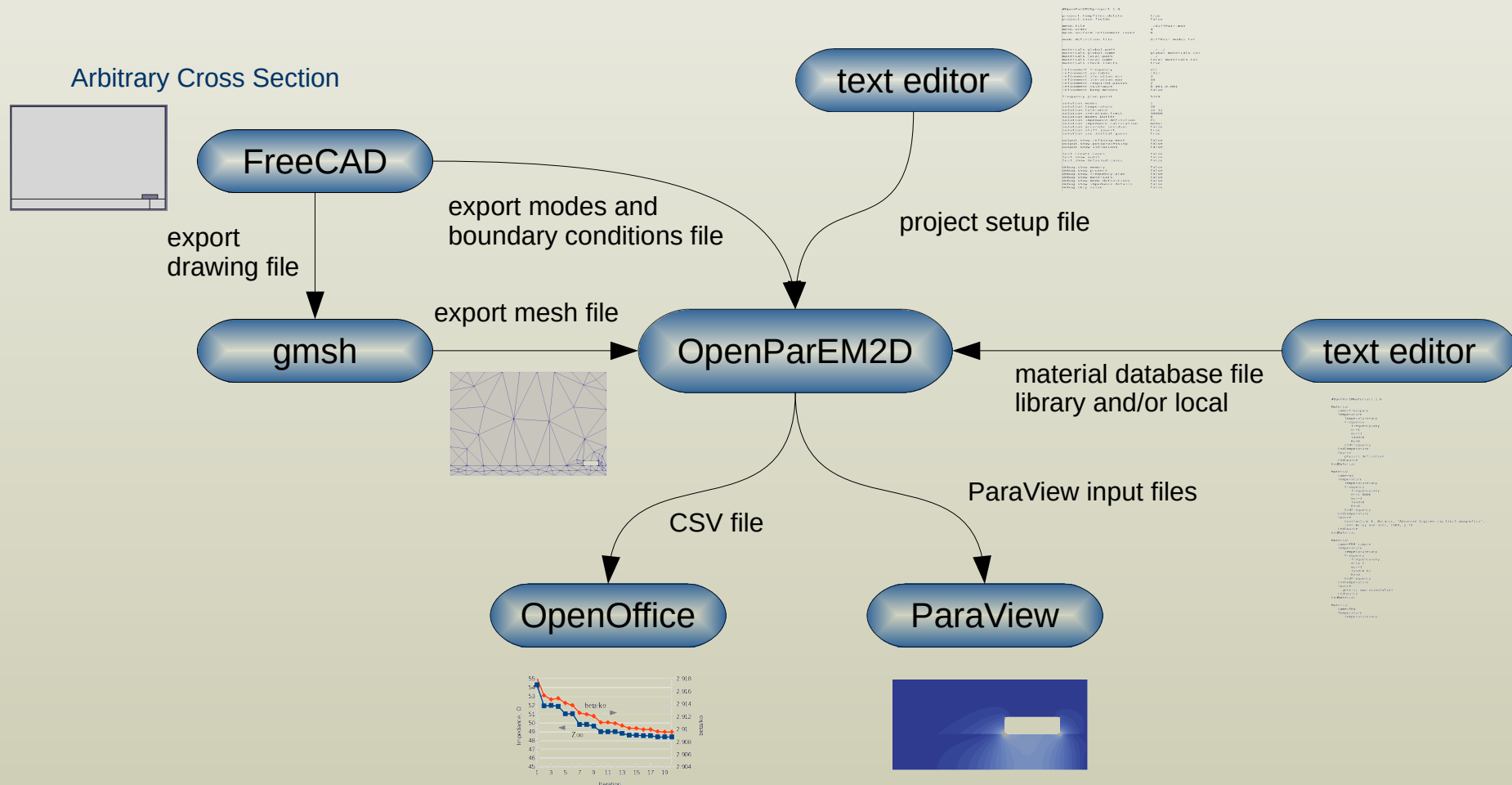
Features

- Full-wave solver
  - simultaneously solves the electric and magnetic fields
- Advanced finite-element method (FEM) with arbitrary high-order elements
- Adaptive mesh refinement
- Parallel processing through the Message Passing Interface (MPI)
- Front-end input file builder for common transmission line and waveguide types.
- Licensed under GPLv3 or later.

Capabilities

- Calculations
  - propagation constant
  - characteristic impedance
  - dielectric loss
  - conductor loss
  - surface roughness loss
  - field distributions
- Dominant and higher-order modes
- Arbitrary cross sections
- Arbitrary high frequencies

Workflow <u>without</u> "builder"

- OpenParEM2D is a command-line tool with text inputs and outputs
- Use with open source tools to create a complete workflow
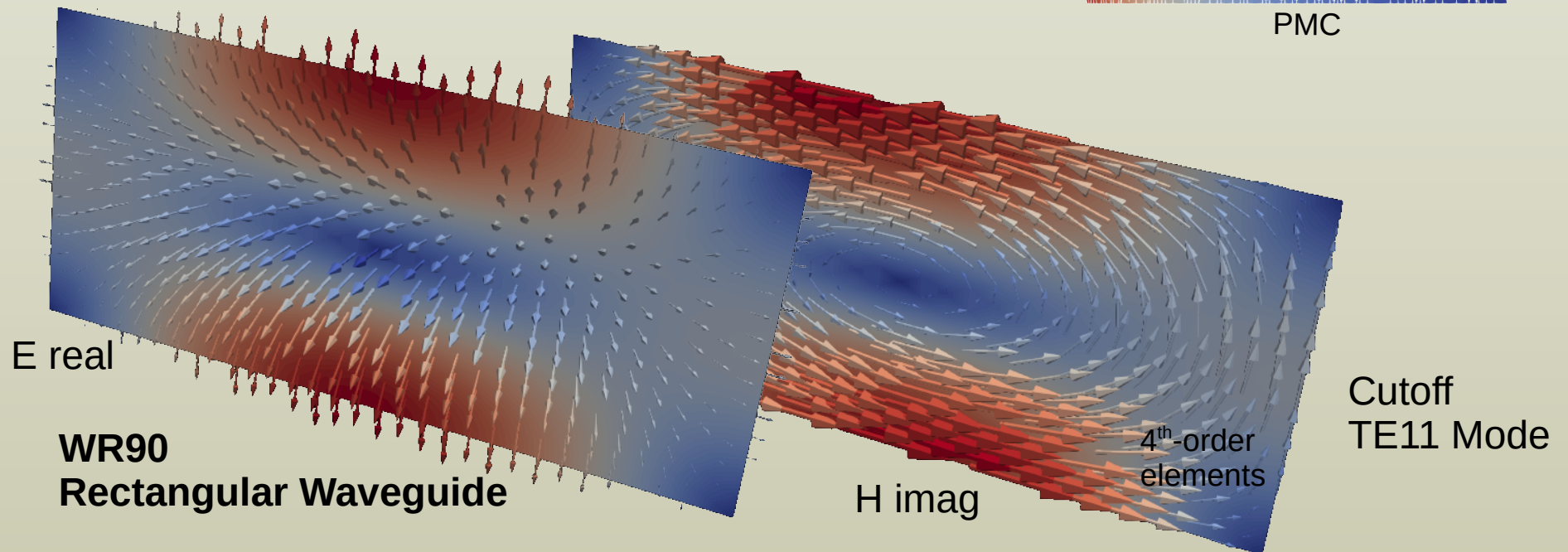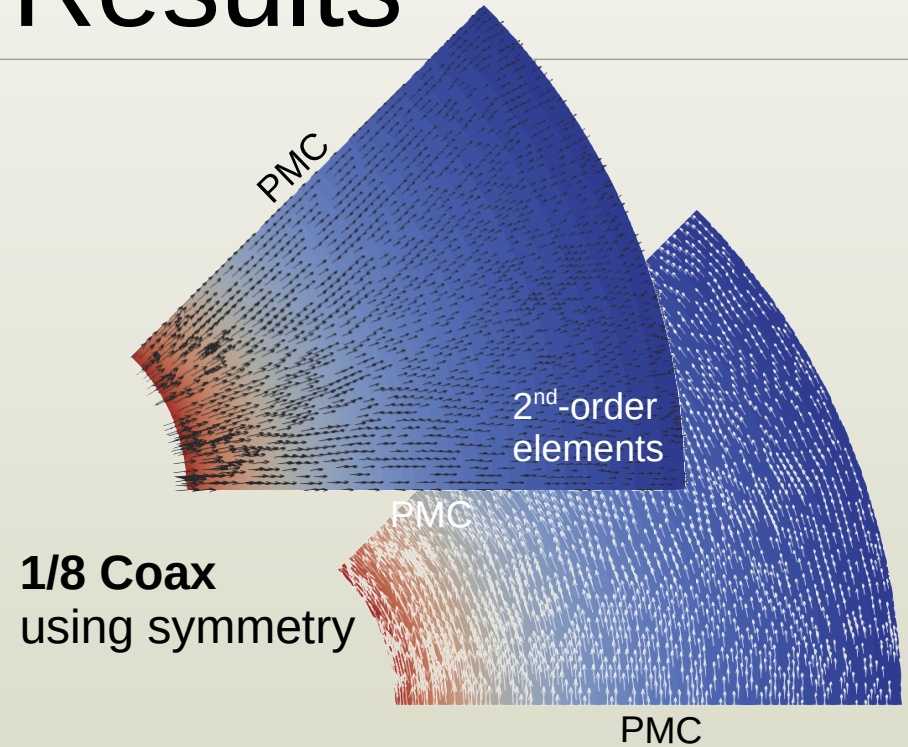- Workflow used for development:

Arbitrary Cross Section

FreeCAD

text editor

export drawing file

export modes and boundary conditions file

project setup file

export mesh file

gmsh

OpenParEM2D

text editor

material database file library and/or local

CSV file

ParaView input files

OpenOffice

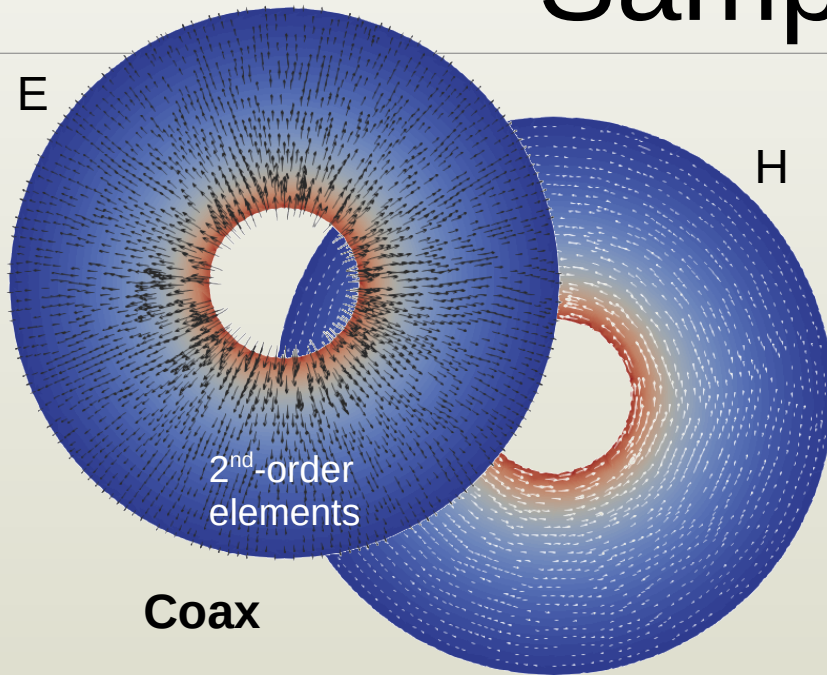ParaView

Workflow <u>with</u> "builder"

- For transmission line and waveguide types supported by the front-end tool "builder", the flow is greatly simplified.
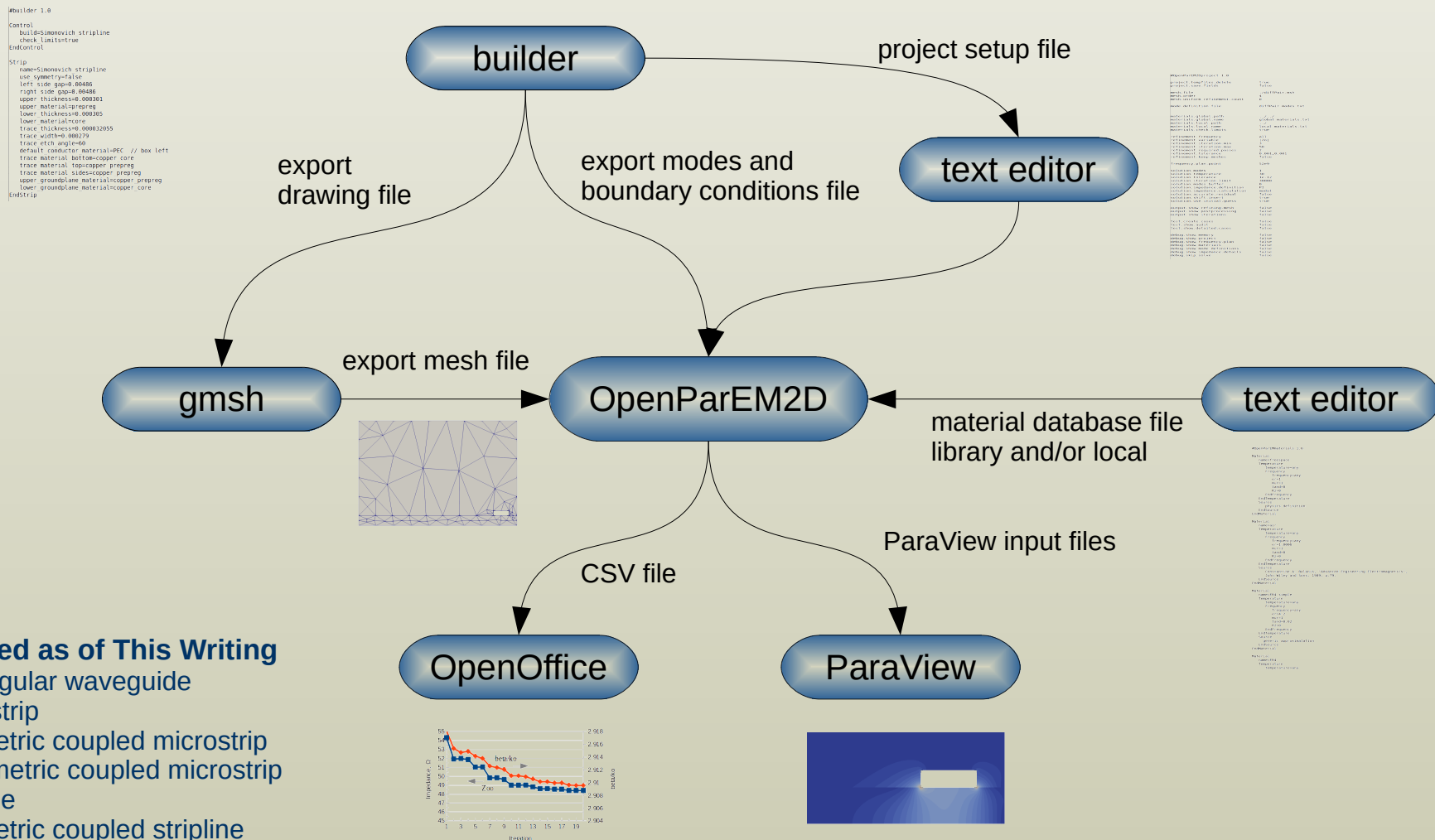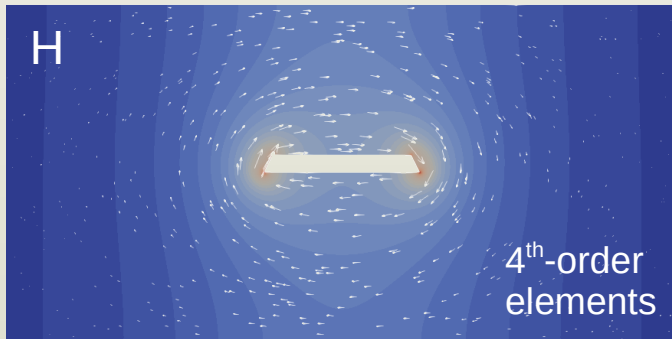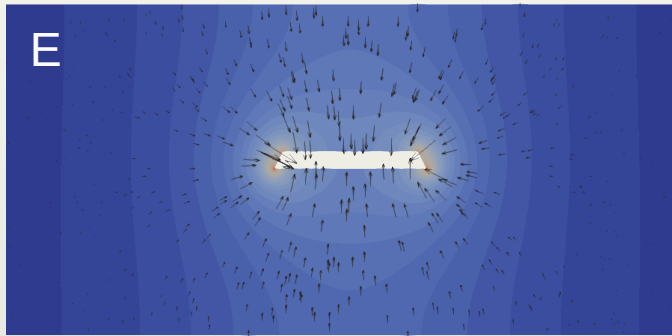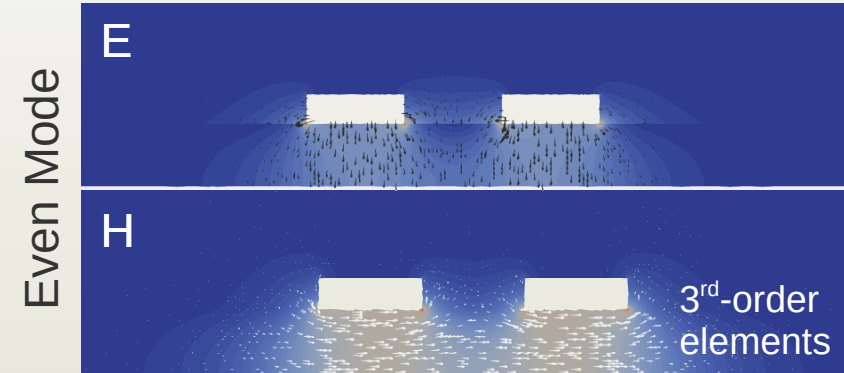

Supported as of This Writing
- rectangular waveguide
- microstrip
- symmetric coupled microstrip
- asymmetric coupled microstrip
- stripline
- symmetric coupled stripline
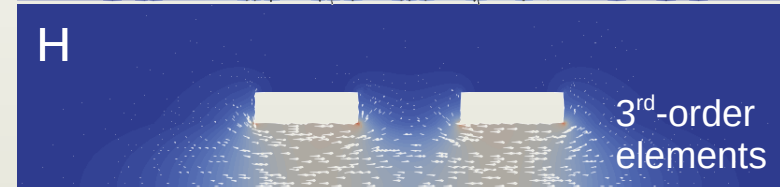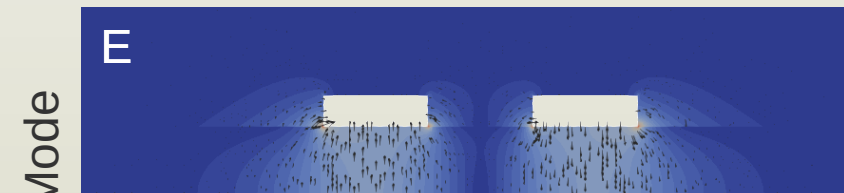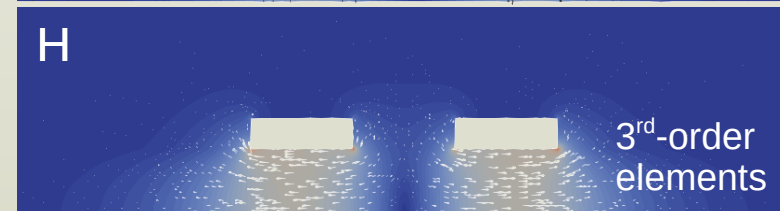- asymmetric coupled stripline

Sample Results

E

H

2nd-order
elements

Coax

PMC

2nd-order
elements

1/8 Coax
using symmetry

PMC

PMC

E real

**WR90
Rectangular Waveguide**

H imag

4th-order
elements

Cutoff
TE11 Mode

Stripline
with etch profile

4th-order elements

Coupled Microstrip

3rd-order elements

Partially-Filled Rectangular Waveguide

$\varepsilon_r=1$

$\varepsilon_r=2.45$

6th-order elements
Mesh Shown
No Adaptive Refinement

Mesh at iteration 1

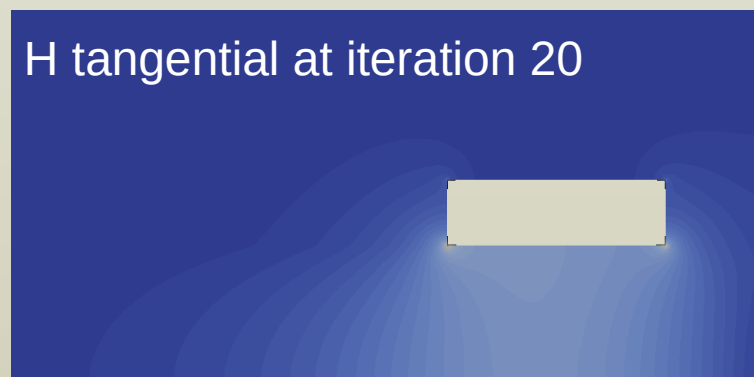Mesh at iteration 20

PEC

PEC
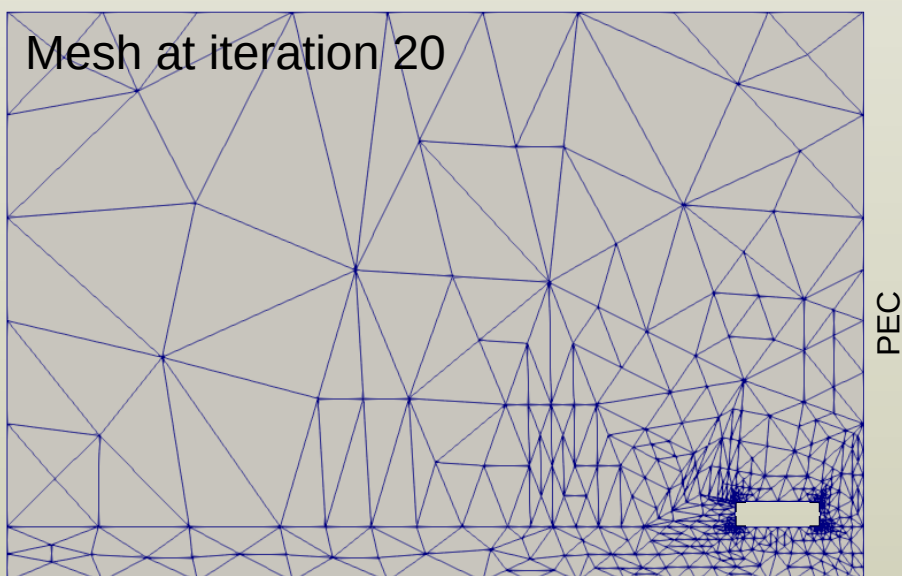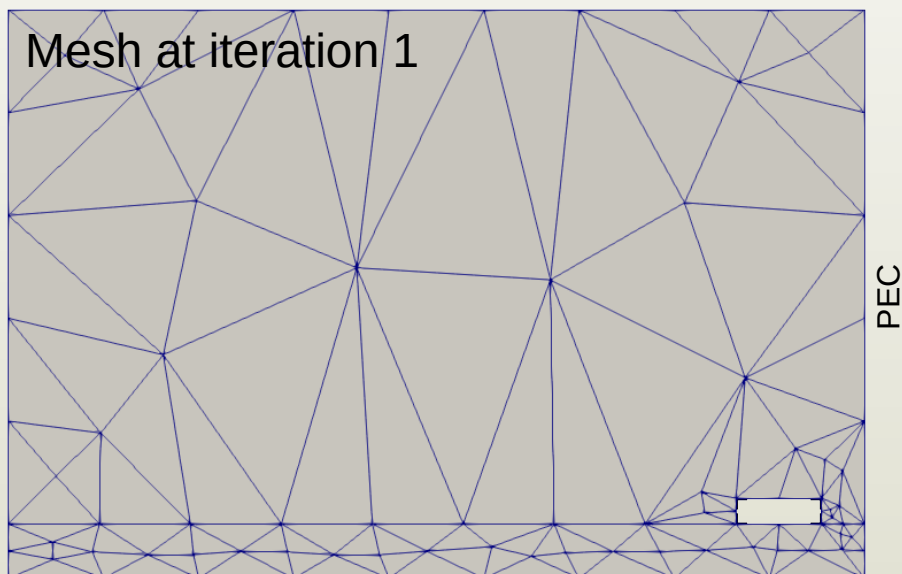
4th-order elements
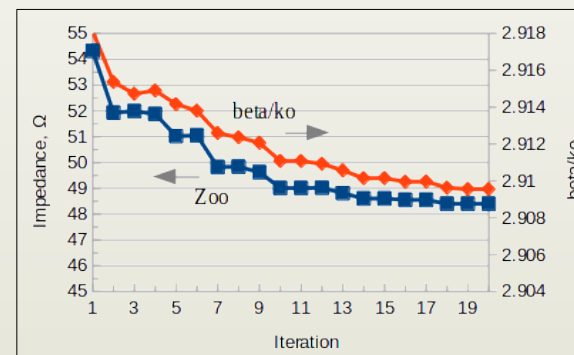
E tangential at iteration 20

H tangential at iteration 20

Odd Mode of Coupled Microstrip