Electromagnetic Simulation Software
-- tutorial --

December 1, 2016

PHYS 402: E&M 2

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-- tutorial --

Login to Computer Terminal
Do NOT open FEKO

December 1, 2016

PHYS 402: E&M 2

Principle Numerical 3D EM Methods

Method of Moments (MoM)

Solves Maxwell's equations in ***integral*** form in the frequency domain.
(boundary conditions included in integral)

→ For discretized volume/surface of sources, integral eq. reduces to a **matrix** eq.

→ Solves matrix eq. **exactly** to get $J(r_i)$ and $\rho(r_i)$.

→ Once $J(r_i)$ and $\rho(r_i)$ are known, then compute $E(r_i)$ and $B(r_i)$.

Finite Element Method (FEM)

Solves Maxwell's equations in ***differential*** form in the frequency domain.

→ Entire solution volume is discretized, boundary cond. imposed explicitly.

→ Diff. eq. become large **sparse matrix eq.**

→ Solves matrix eq. ***approximately*** to get $E(r_i)$, and thus $B(r_i)$, $J(r_i)$, and $\rho(r_i)$.

Finite Difference Time Domain (FDTD)

Solves Maxwell's equations in differential form in the time domain.

→ Staggered E and B cubic discretization lattices (MoM/FEM → triangle discr.)

→ Calculate E → calculate B → time-step forward → calculate E, etc …

Commercial 3D EM Solvers

FEKO (part of Altair Inc.)

→ primary solver: MoM
→ also uses FEM, FDTD, and hybrid MoM-FEM.

HFSS (part of ANSYS)

→ primary solver: FEM
→ also uses hybrid MoM-FEM

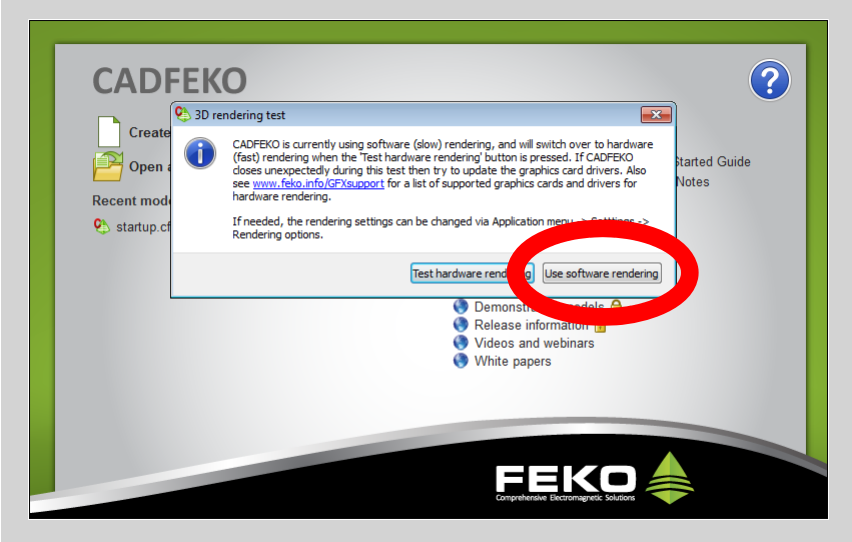
COMSOL Multiphysics (AC/DC and RF modules)

→ primary solver: FEM

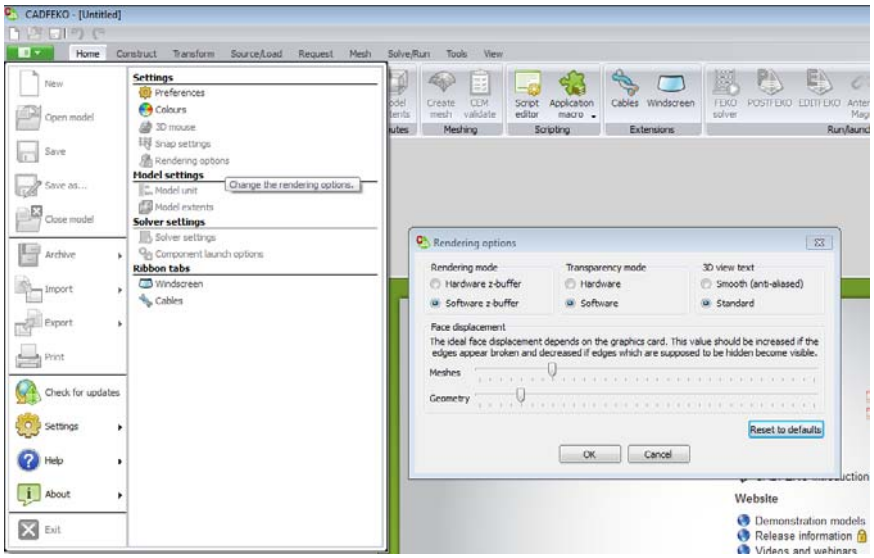
CST Microwave Studio (by CST)

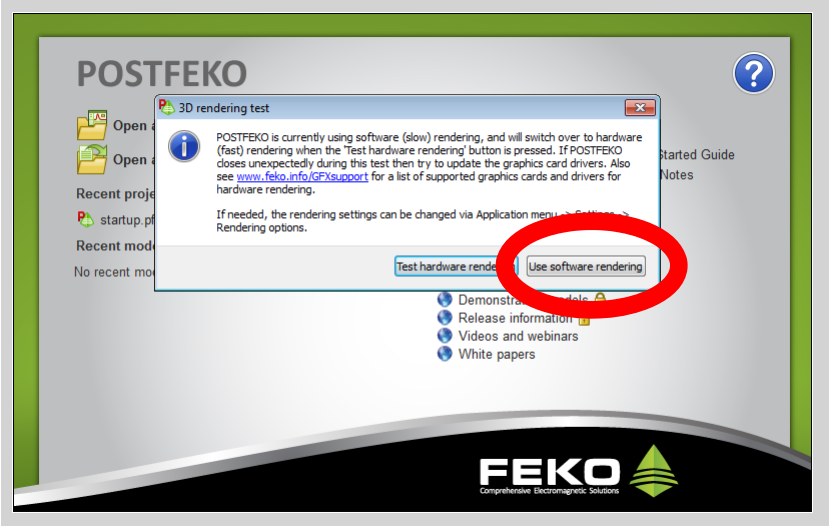
→ primary solver: FDTD (with some integral eq. solving also).

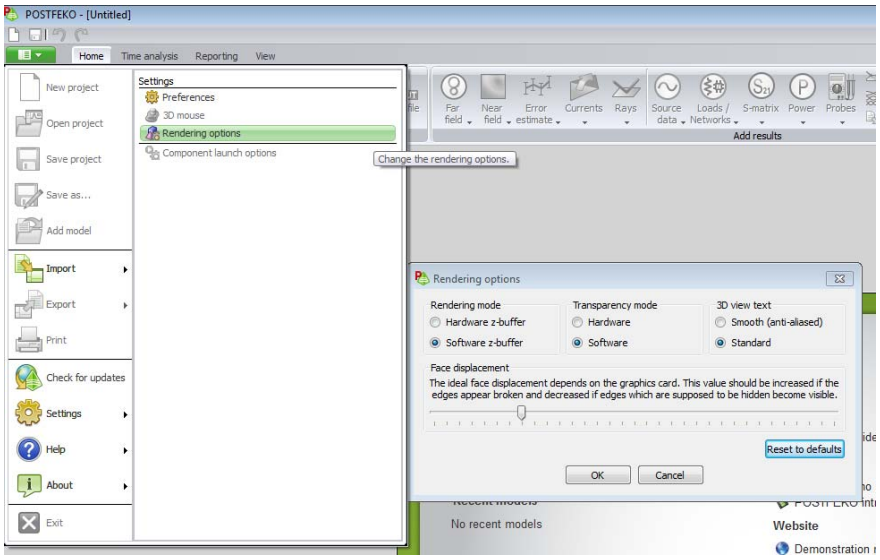
Open CADFEKO



Just in case: Adjusting the Rendering







FEKO workflow

Construct model → Insert Sources/Loads → Specify calculation requests → Mesh model → Solve/Run model

FEKO workflow

CADFEKO

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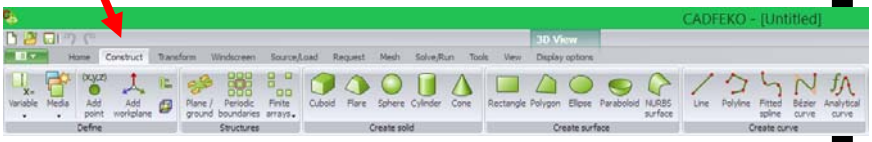

POSTFEKO

FEKO workflow

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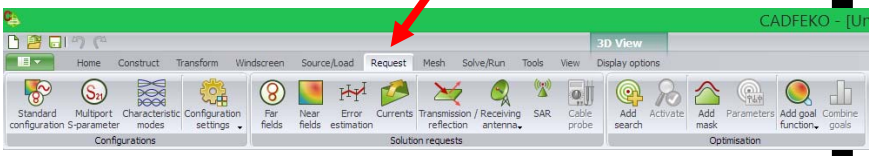

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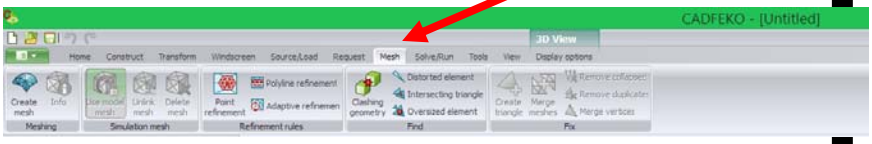

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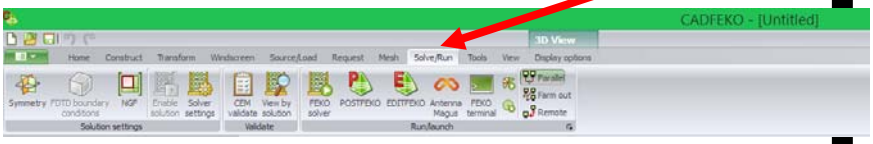
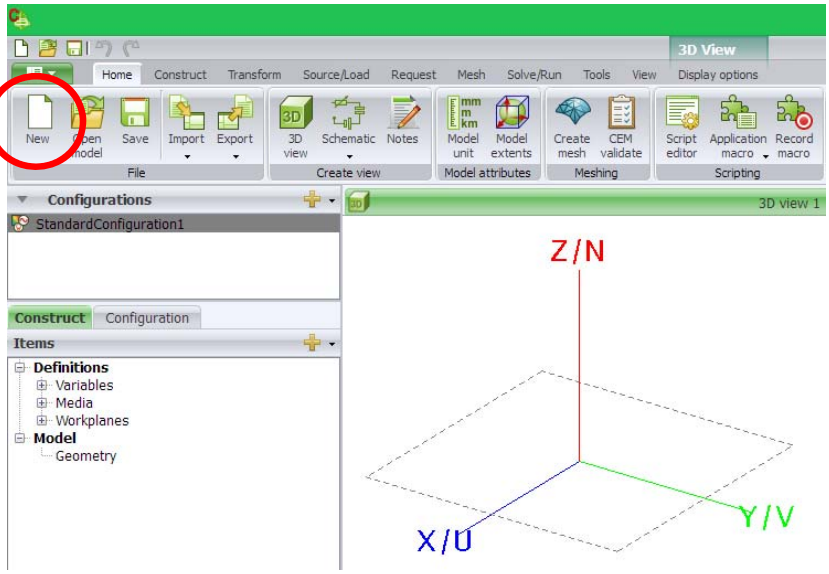


POSTFEKO

Step “Zero”

CADFEKO

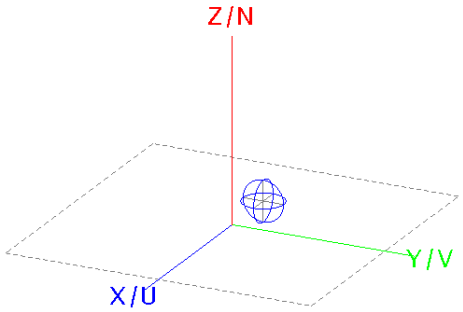


FEKO: 3D perspective navigation

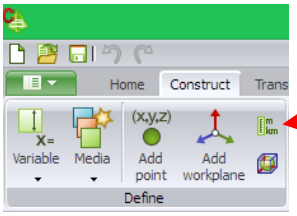
Rotation: Mouse-left-click + drag

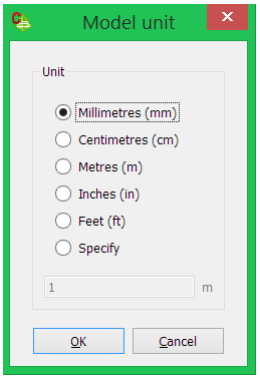
Zoom: Shift + Mouse-left-click + drag vertical

Translate: Ctrl + Mouse-left-click + drag



Dipole Antenna: Construction definitions





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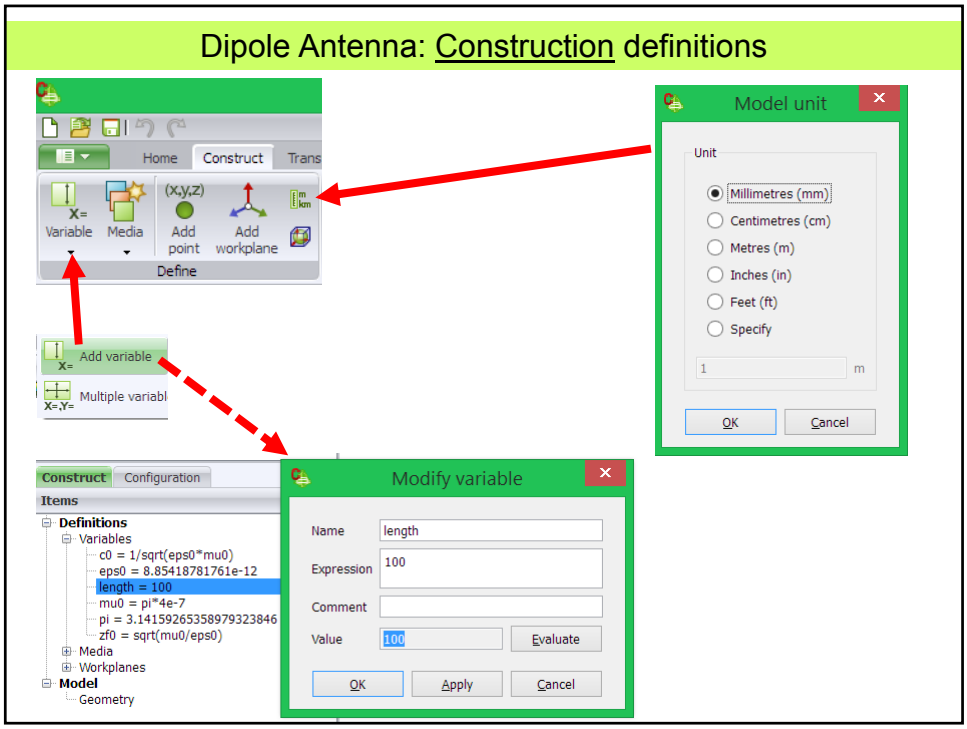

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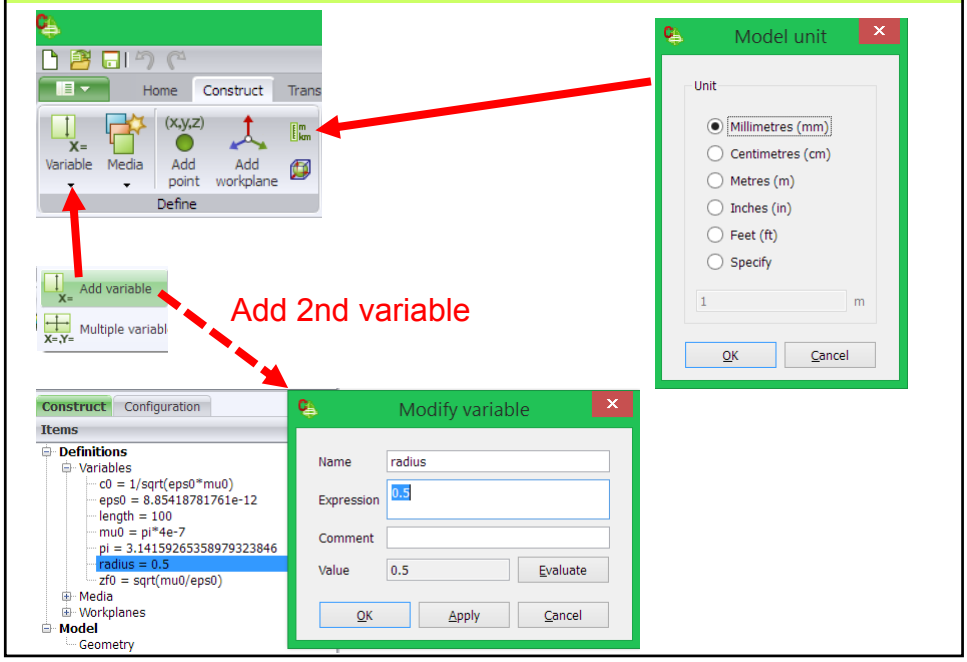

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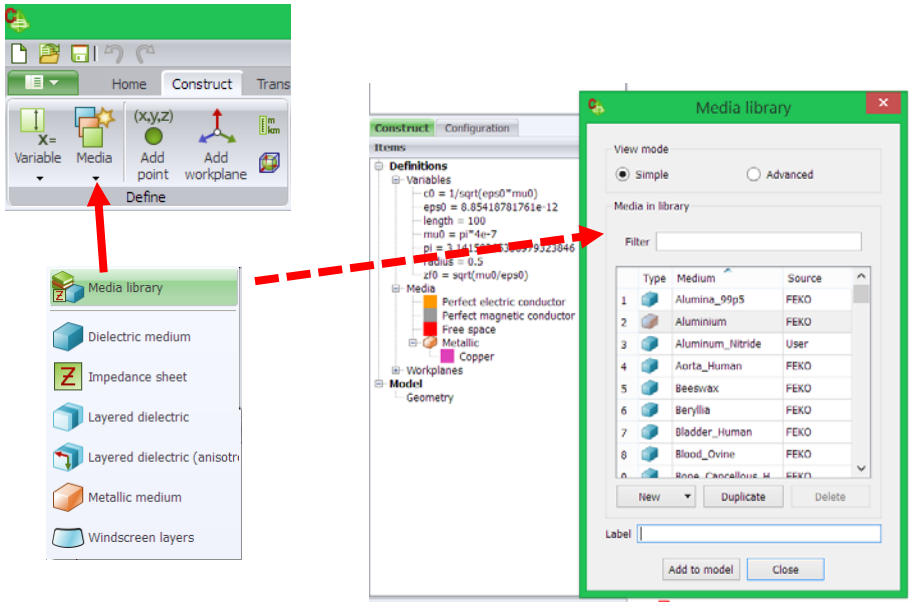
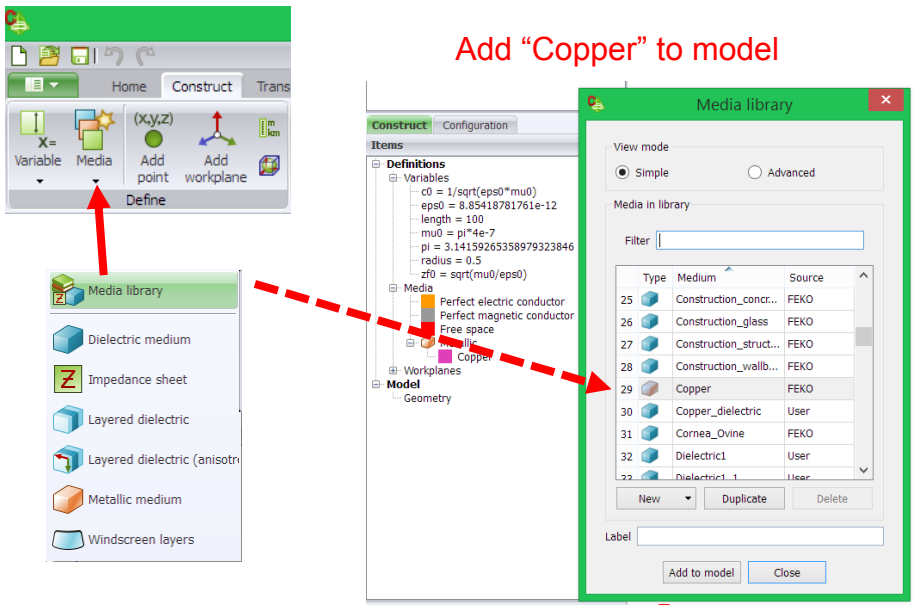
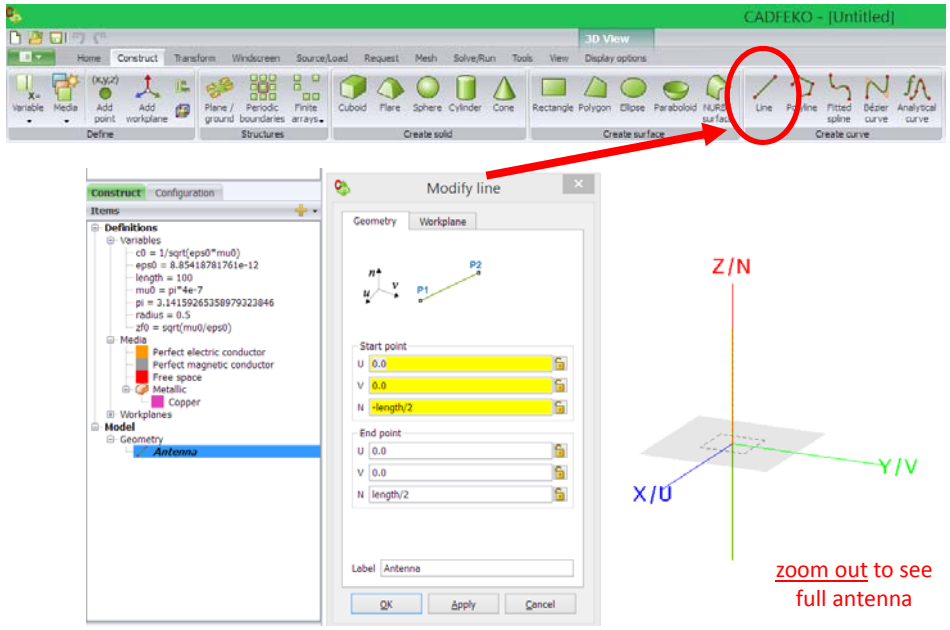


Dipole Antenna: Construction definitions

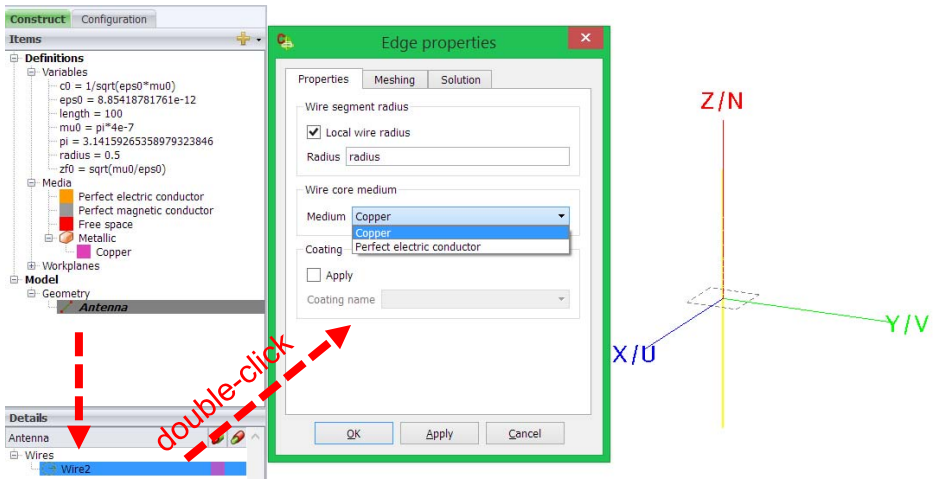
Add "Copper" to model



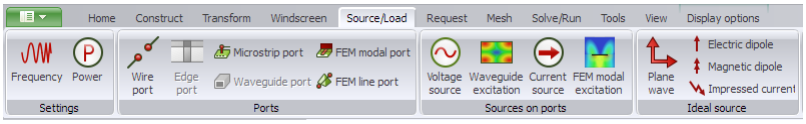
Dipole Antenna: Construct **Antenna**



Dipole Antenna: Construct **Antenna** → assign material



Dipole Antenna: Excitation Source



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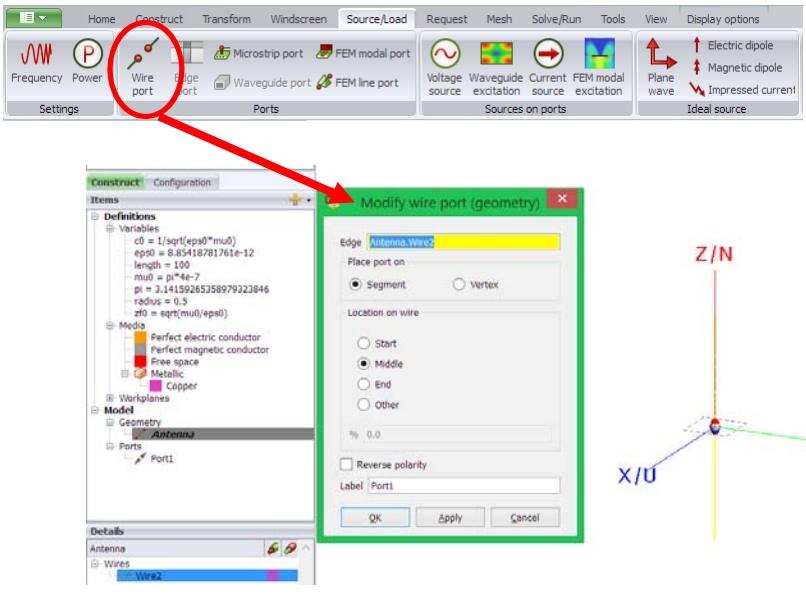

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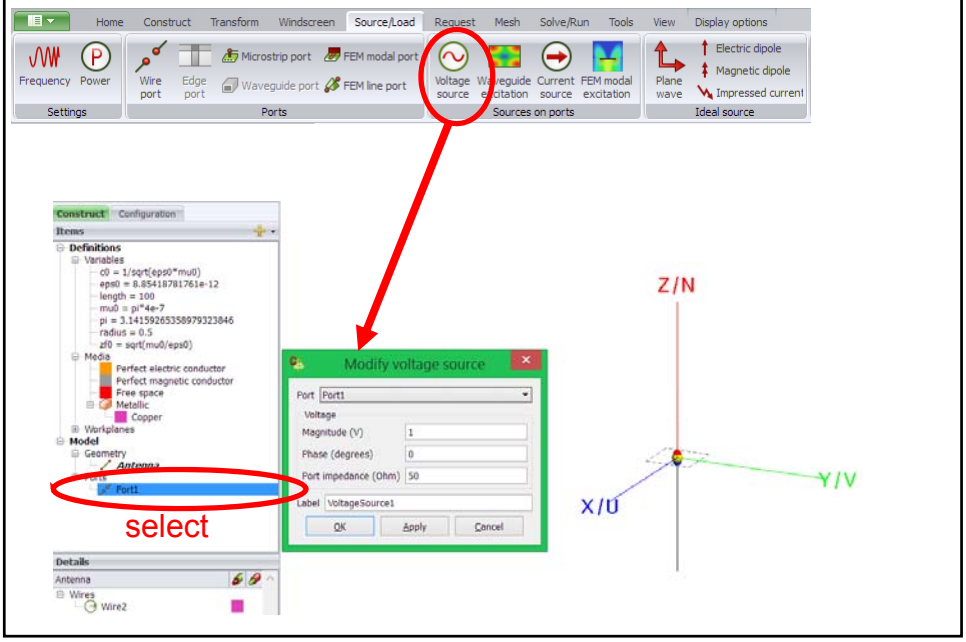
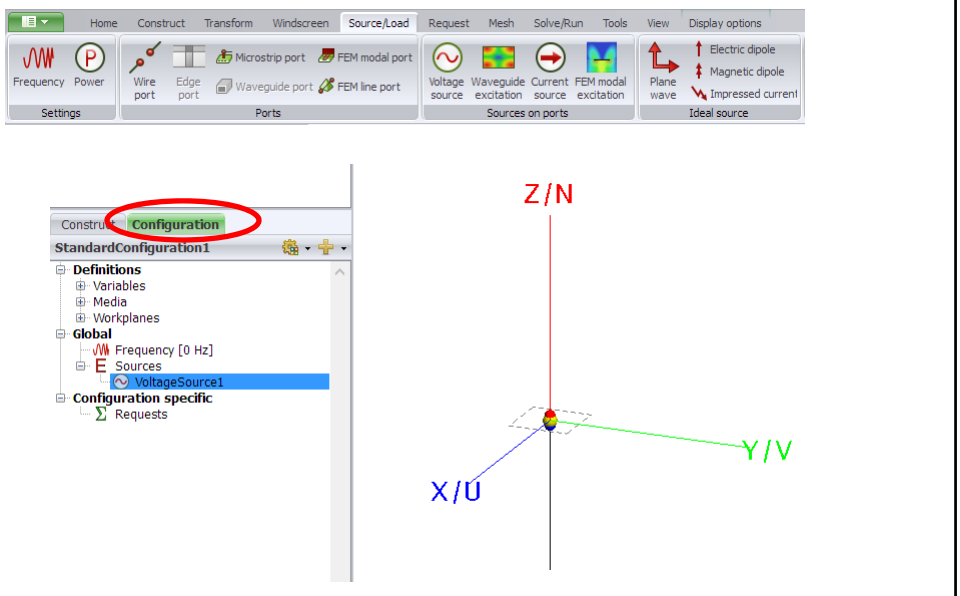
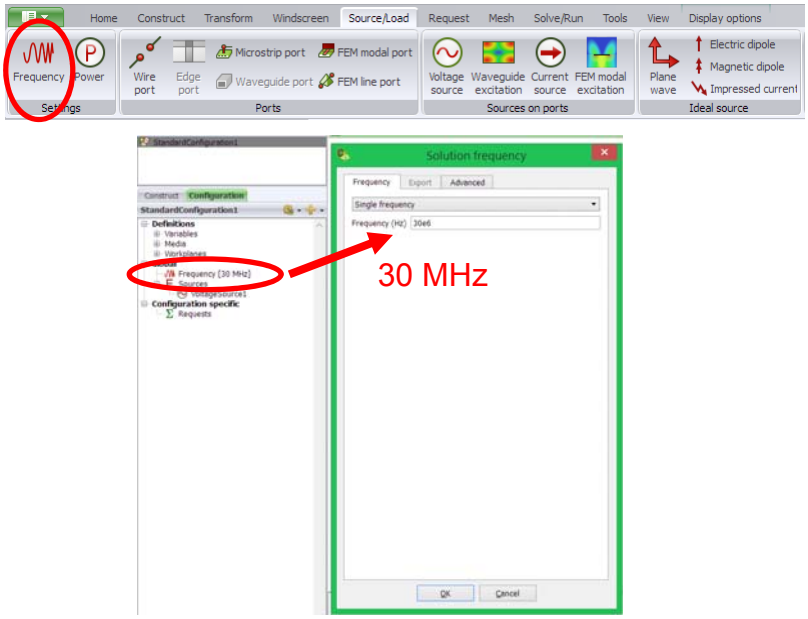


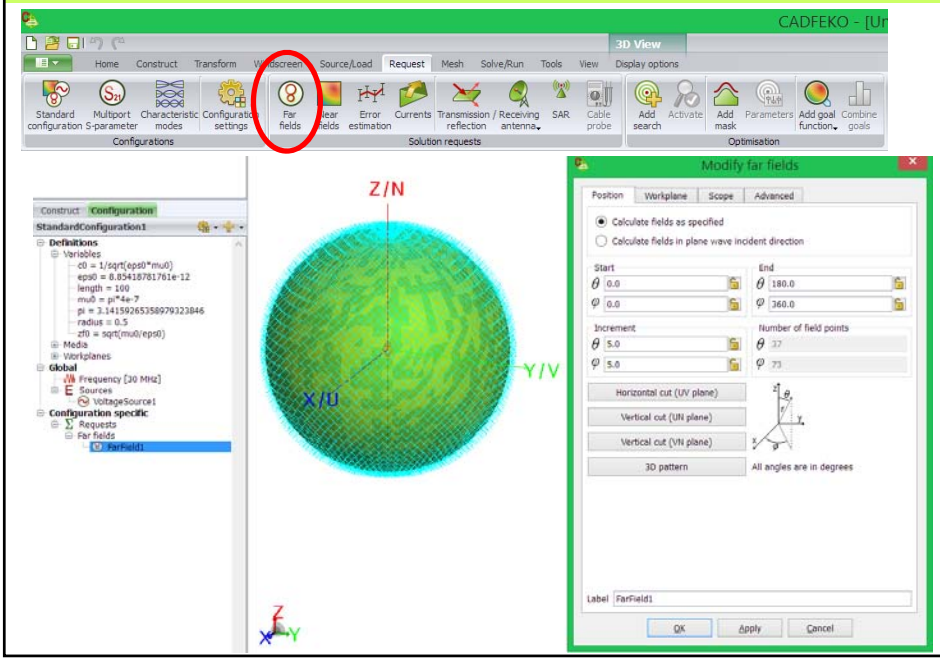
Dipole Antenna: model **configuration**



Dipole Antenna: set solution **Frequency**



Dipole Antenna: Calculation Requests



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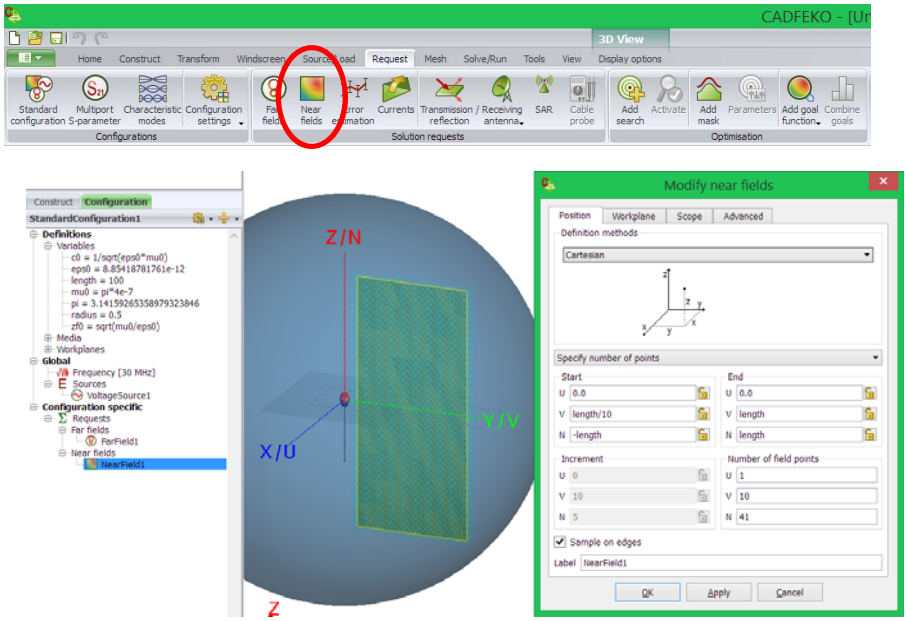

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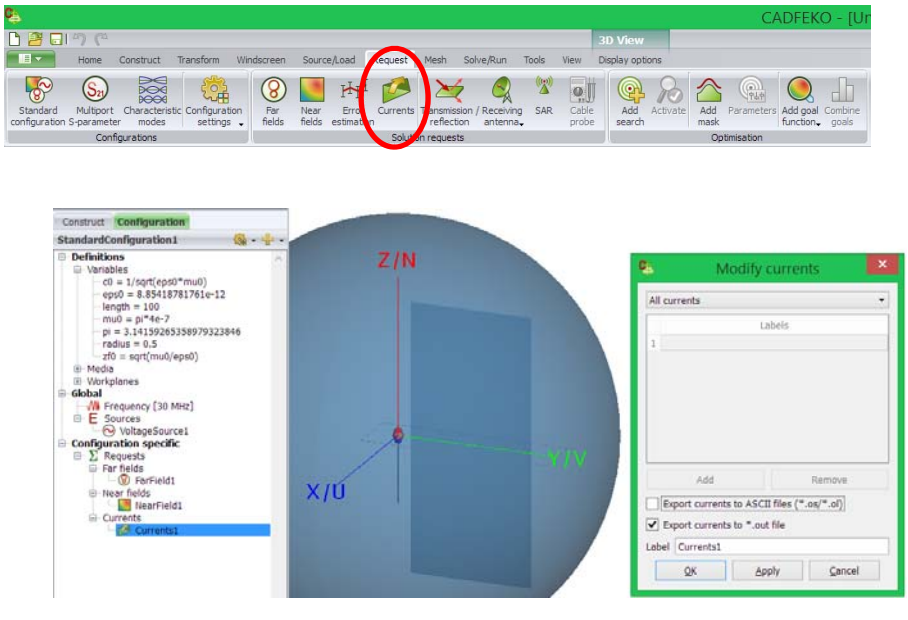
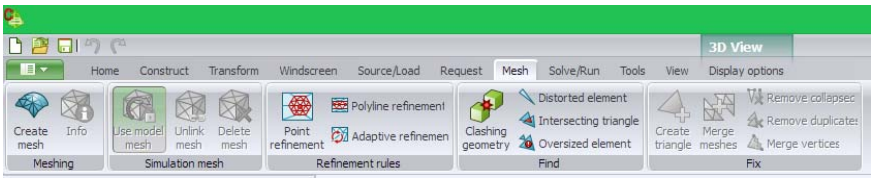


Dipole Antenna: **Mesh** the model



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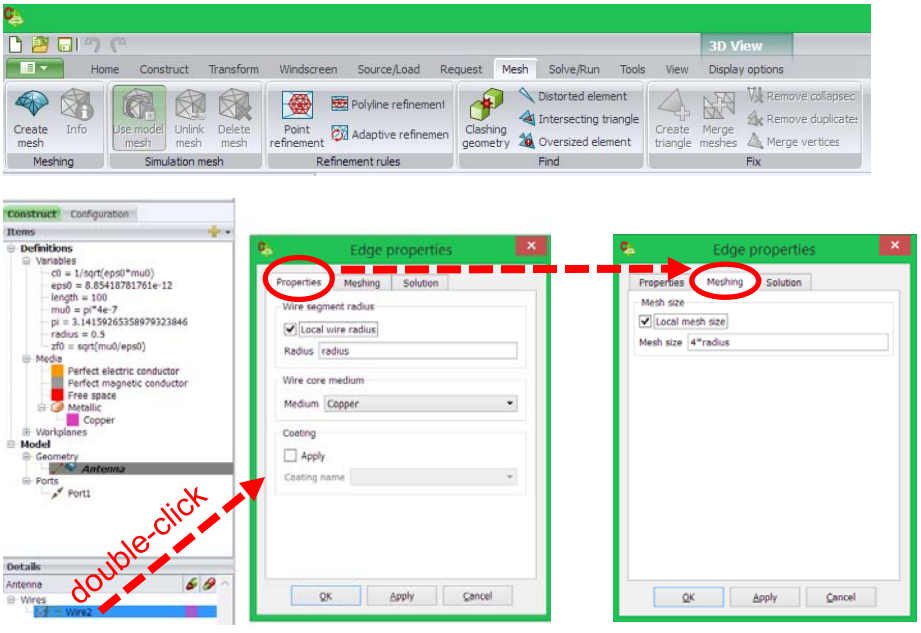

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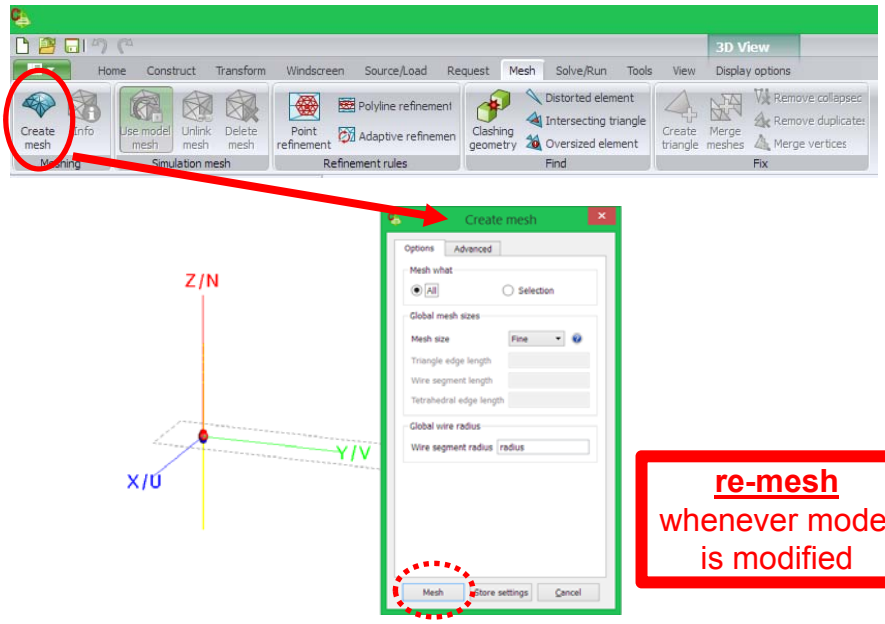
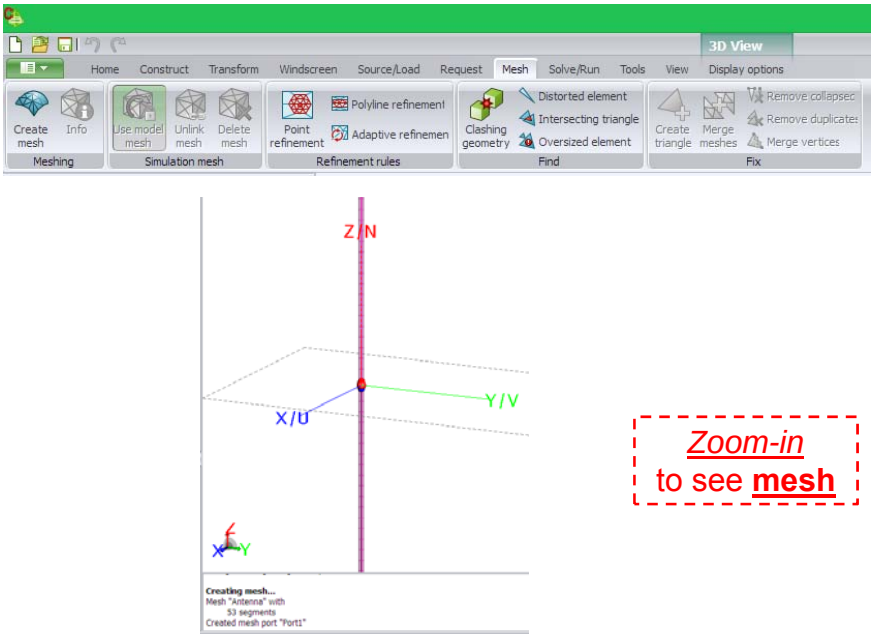


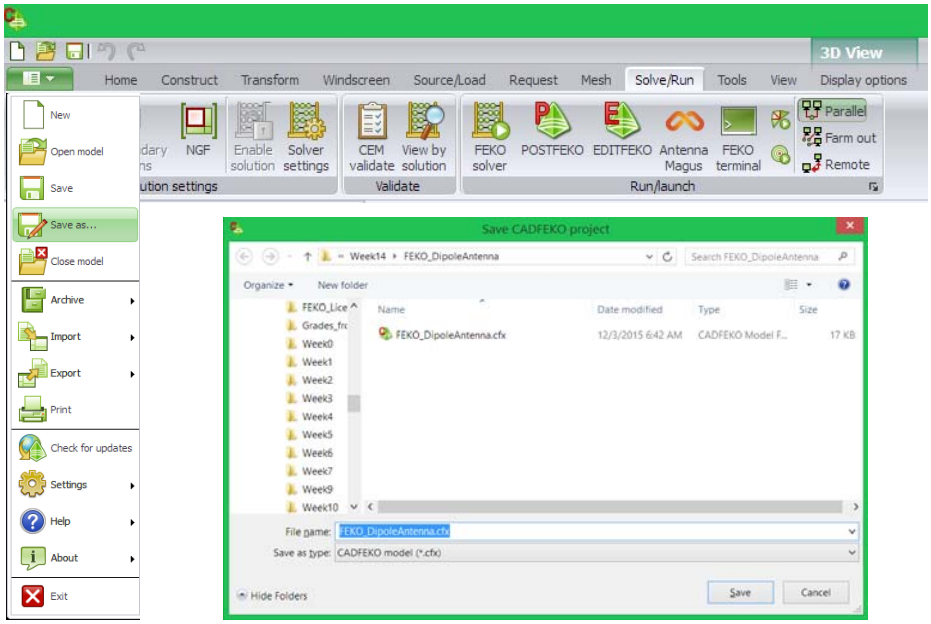
re-mesh whenever model is modified

Dipole Antenna: **Mesh** the model

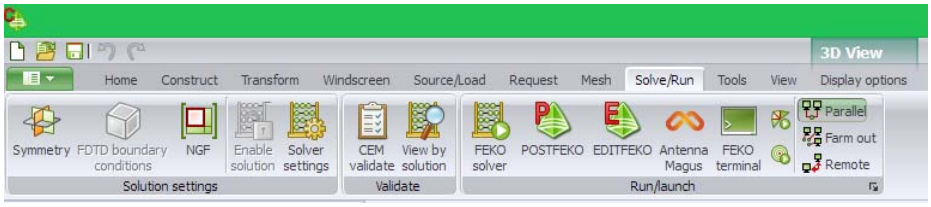


Zoom-in to see **mesh**

Dipole Antenna: **Save** the model



Dipole Antenna: **Solve** the model



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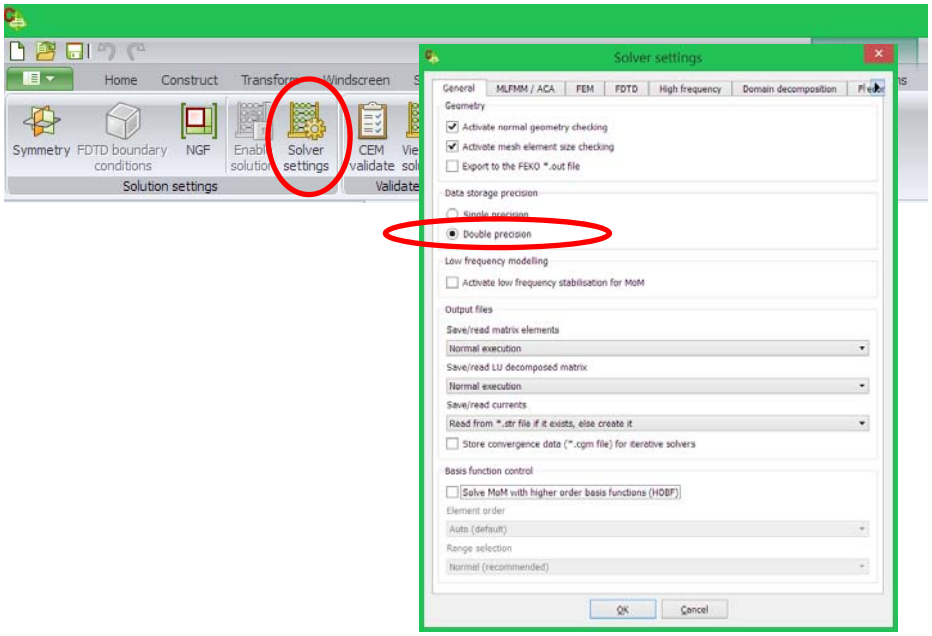

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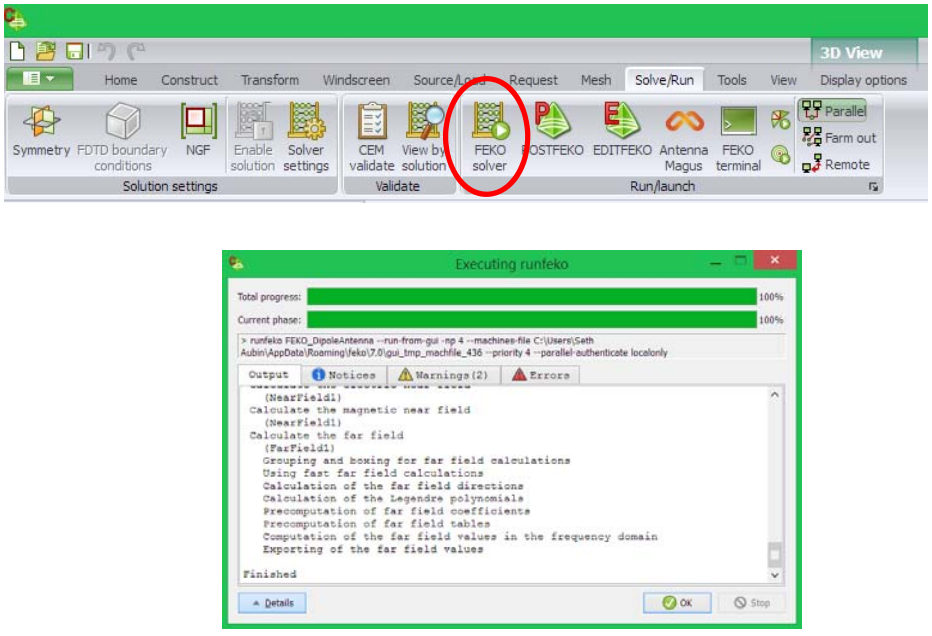

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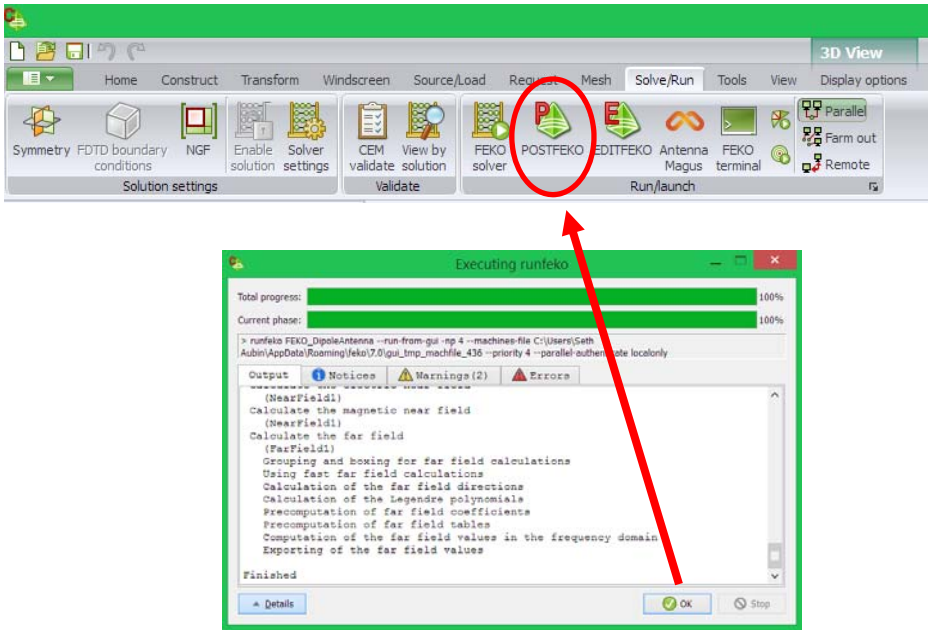
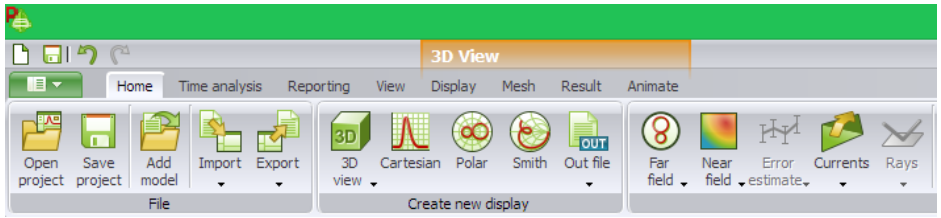


POSTFEKO: Analysis of Solutions



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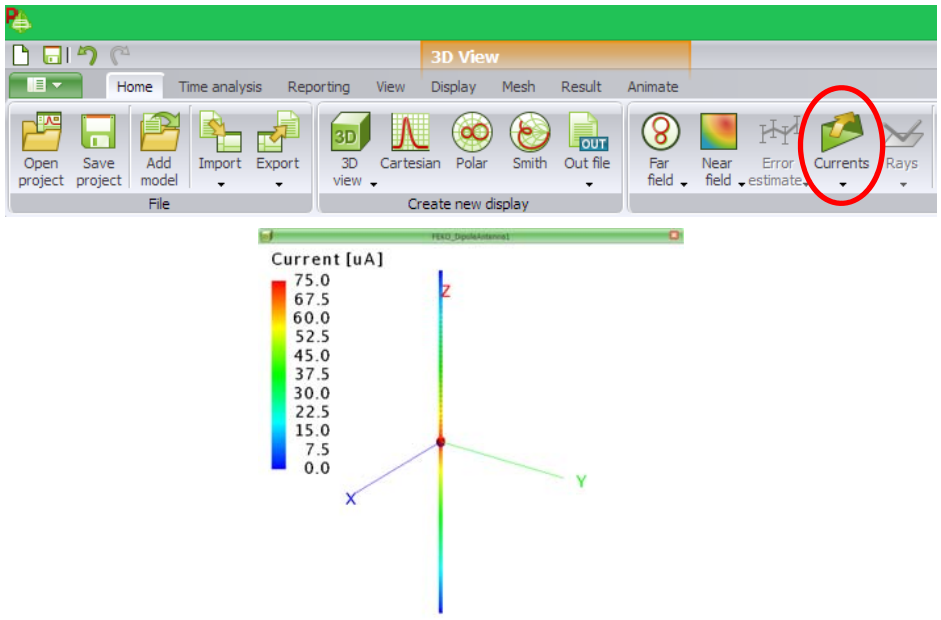

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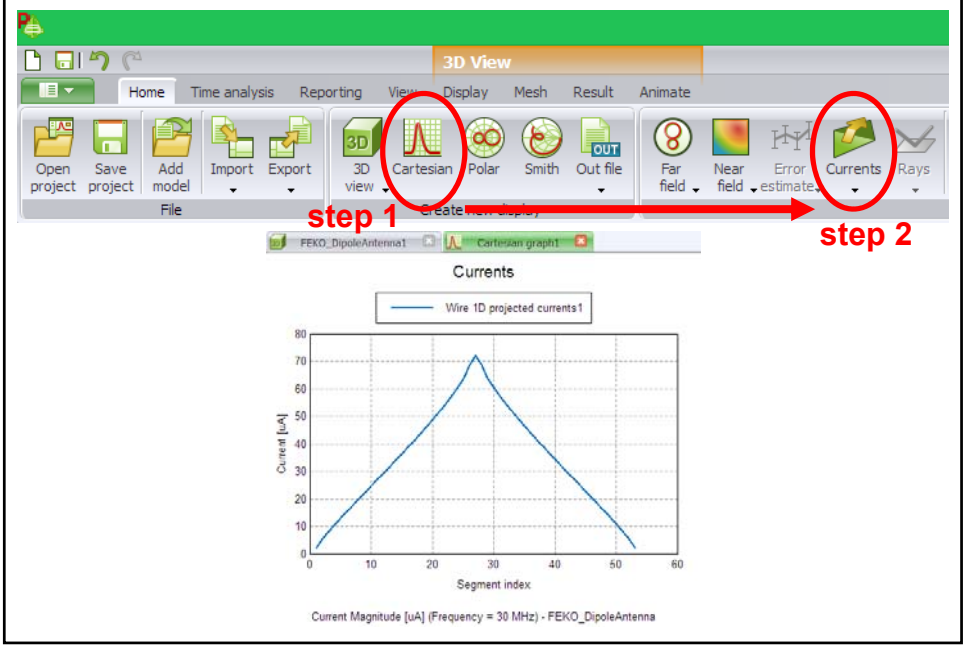

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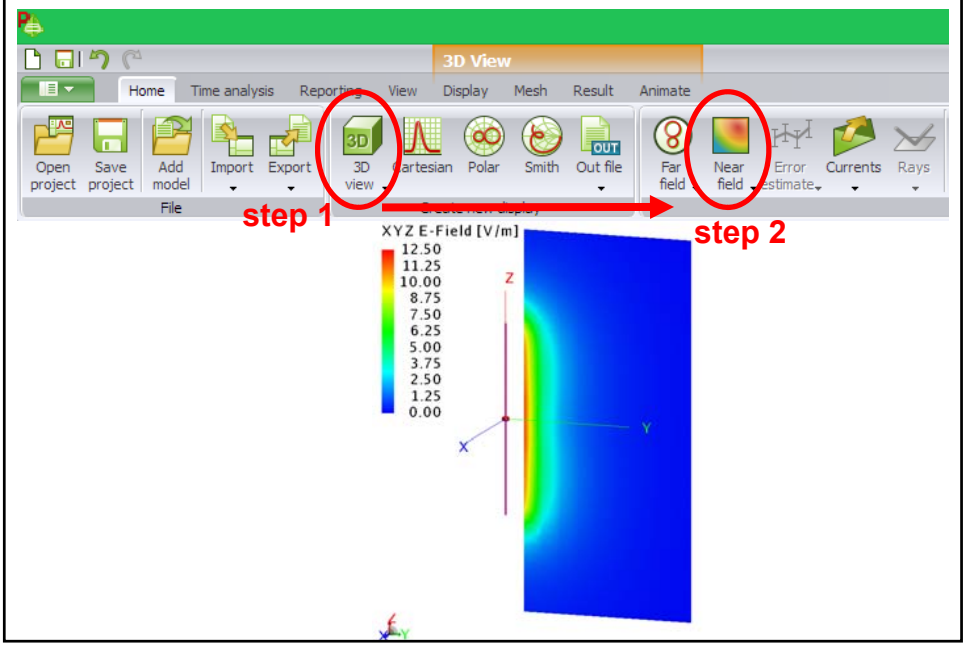

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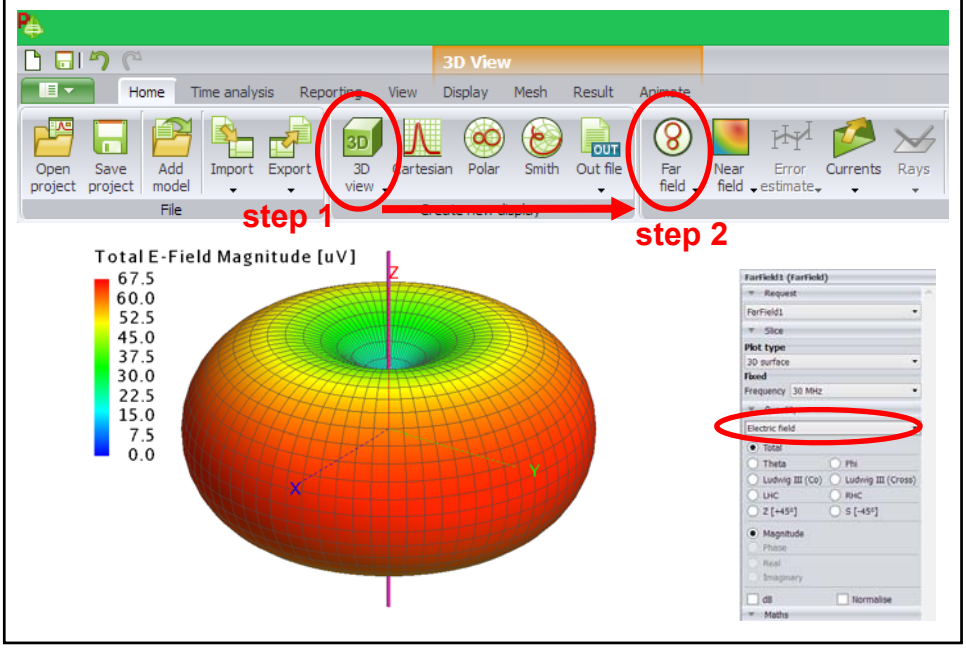

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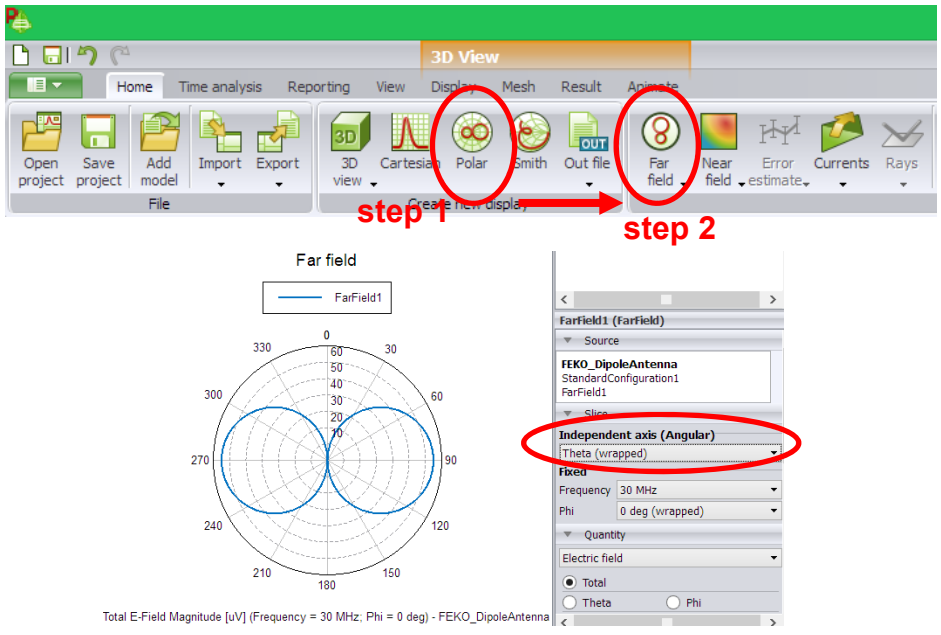

Exercises

Calculate the Current and Far-Field (Gain or E-field) for the following:

1. Length = $\lambda/2$ or λ

2. Length = $3\lambda/2$, 2λ, or 5λ