Q: How to solve current and voltage?

A: Two methods are provided herein.
(1) Solve voltage and current using S-parameters.
(2) Integrating an electric field along an integral path yields a voltage.

Please refer to the next few slides.

Additional Information

(1) Solve current and voltage using S-parameters.

$$\begin{pmatrix} b_1 \\ b_2 \end{pmatrix} = \begin{bmatrix} S_{11} & S_{12} \\ S_{21} & S_{22} \end{bmatrix} \begin{pmatrix} a_1 \\ a_2 \end{pmatrix} \tag{1}$$

$$a_m = \frac{v_{mi}}{\sqrt{Z_{ref}}} \qquad b_m = \frac{v_{mr}}{\sqrt{Z_{ref}}} \tag{2}$$

$$v_m = v_{mi} + v_{mr} \qquad i_m = \left(v_{mi} - v_{mr}\right) / Z_{ref} \tag{3}$$

where vm: Voltage at Port m, im: Current at Port m, vmi: Voltage of incident wave, vmr: Voltage of reflected wave, and Zref: Reference impedance.
The initial condition of the analysis result is an input power of 1 [W] from Port 1, which corresponds to a1 = 0 and a2 = 0 in equation (1).
The voltage and current at Port 1 are given as follows.

$$v_{1i} = \sqrt{Z_{ref}} \tag{4}$$

$$v_{1r} = S_{11} \cdot \sqrt{Z_{ref}} \tag{5}$$

$$v_1 = v_{1i} + v_{1r} = (1 + S_{11})\sqrt{Z_{ref}} \tag{6}$$

$$i_1 = (1 - S_{11}) / \sqrt{Z_{ref}} \tag{7}$$

Additional Information

(2) Integrating an electric field along an integral path yields a voltage.

On the [Results] tab, click the field and select [Electric Field] on the drop-down list. Then click the component and select [Absolute] on the drop-down list.

Select the edge of interest to select and execute [Integral] on the right-click menu.

The integration yields the amplitude of the voltage. ($V = \int E \cdot dl$)

By applying the impedance, Z, that is obtained at Z_para in the result table to V=IZ, the current will be obtained. (Herein, the amplitude of the current will be obtained)

Please refer to Example 28 on the Femtet help menu below for more information.

Home>Examples>Electromagnetic Analysis [Hertz] > Example 28: Coil-to-coil Power Transfer