Comparison between C++ and Matlab PEEC fullwave solvers

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Introduction

In this report comparison between a C++ and a Matlab bases PEEC fullwave solver is presented. The solvers have been developed in parallel over a long period and thus require rigorous testing.

As the test geometry the zero thickness patch in Fig. 1 is choosen. The geometry is choosen for it's simplicity and short simulation time. But, even for this simple geometry all electric and magnetic interactions are present and must be accounted for in a correct way. The patch is 5 x 5 mm and is discretized into four equal sized capacitive cells. The partial inductances are also a total of four.

In the tests presented in the next section four different PEEC models to represent the 5 x 5 mm patch are used. They are: (1) PEEC models where closed formulas are used to calculate the self and mutual partial elements and where no retardation(static) is included. (2) PEEC models where closed formulas are used to calculate the self and mutual partial elements and where retardation(fullwave) is included. (3)PEEC models where closed formulas are used to calculate the self partial elemets and a surface formulation using a 5th order Gauss-Legendre numerical integration technique is used to calculate the mutual partial elements and where no retardation(static) is included. (4)PEEC models where closed formulas are used to calculate the self partial elemets and a surface formulation using a 5th order Gauss-Legendre numerical integration technique is used to calculate the mutual partial elements and where retardation(fullwave) is included.

The resulting PEEC is solved using the MNA method.

In the tests the relative error for node voltages and input impedances are displayed. The relative error for the node voltages are calculated as shown in (1).

$$V_r = \frac{|V_{C++} - V_{Matlab}|}{|V_{Matlab}|} \tag{1}$$

And the relative error in the input impedance is calculated in the same way.
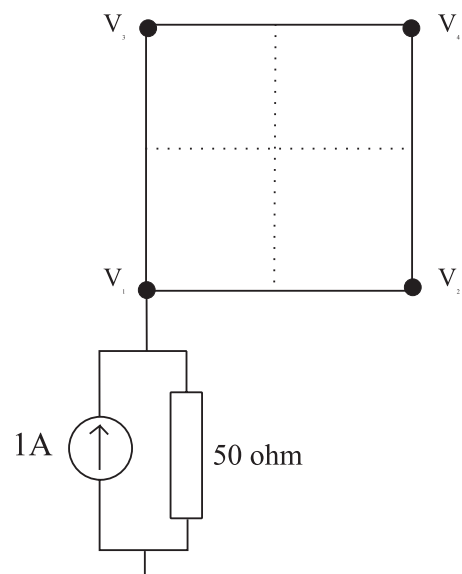
1

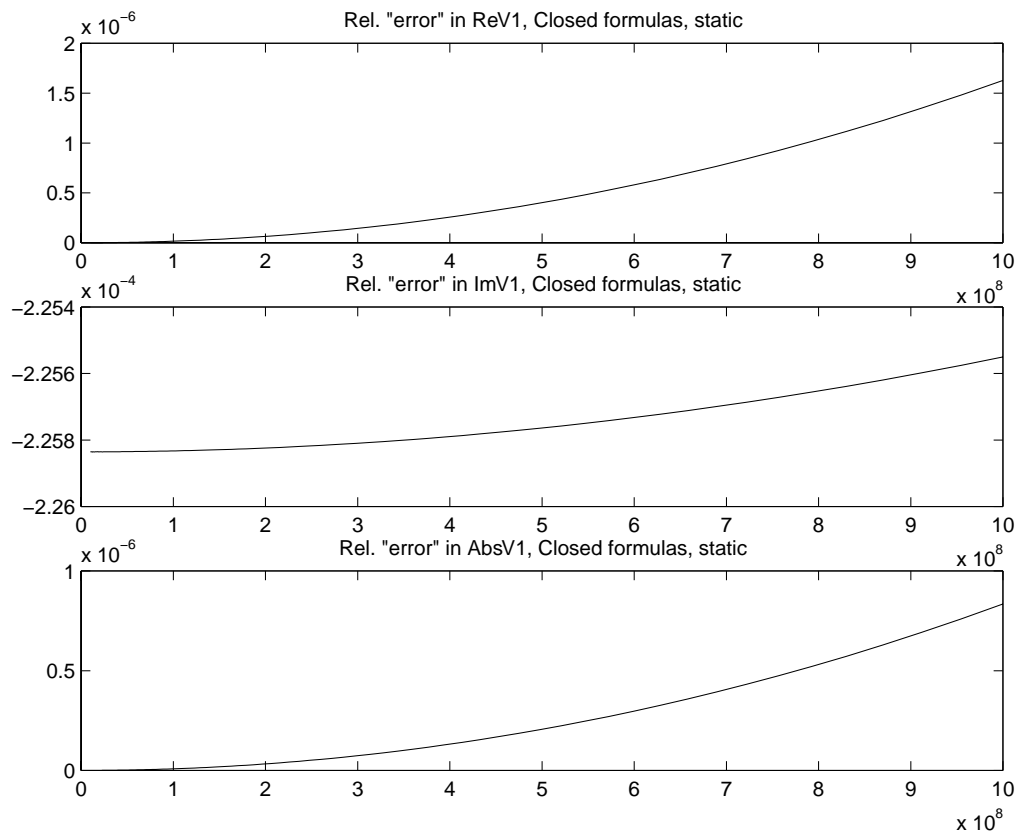Figure 1: 5 x 5 mm zero-thickness patch used in tests

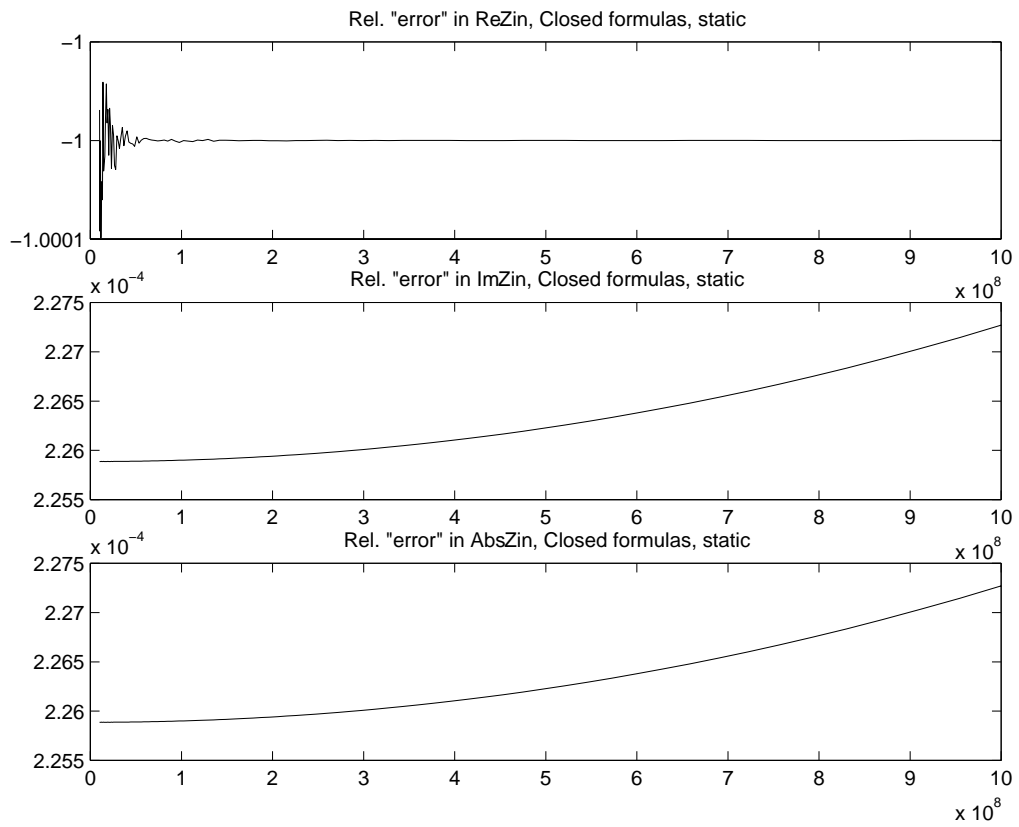# Results

Figure 2: Closed formulas, static, V(1)

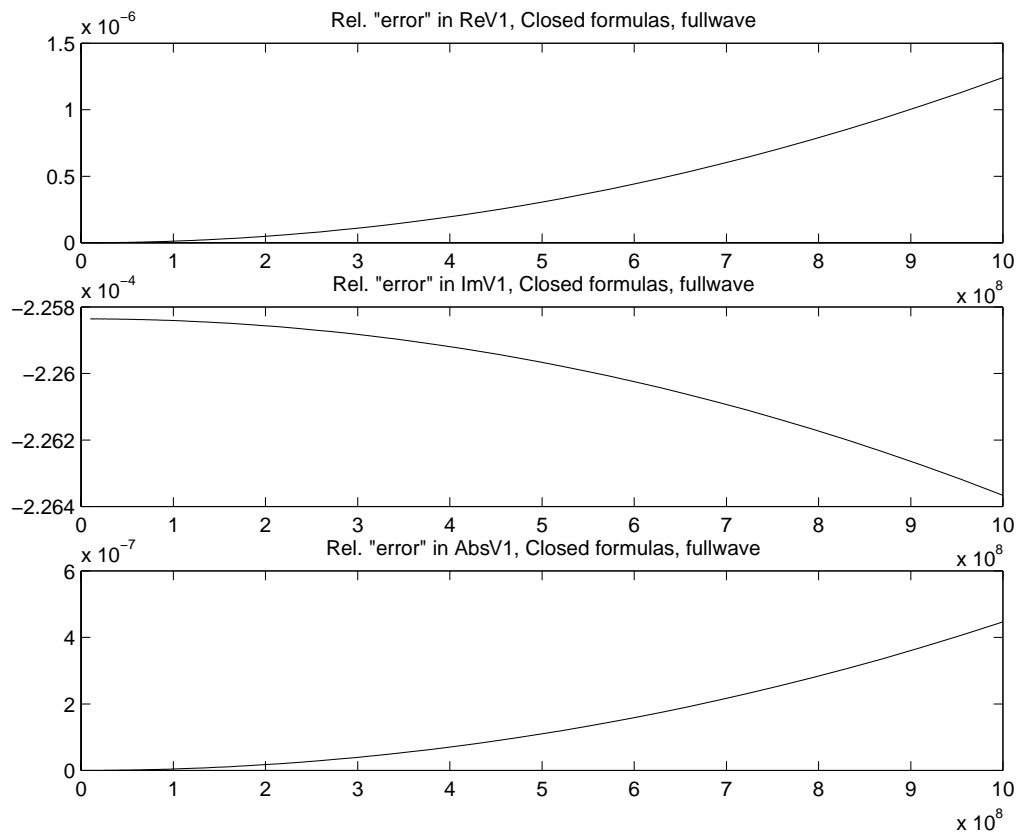Figure 3: Closed formulas, static, Zin
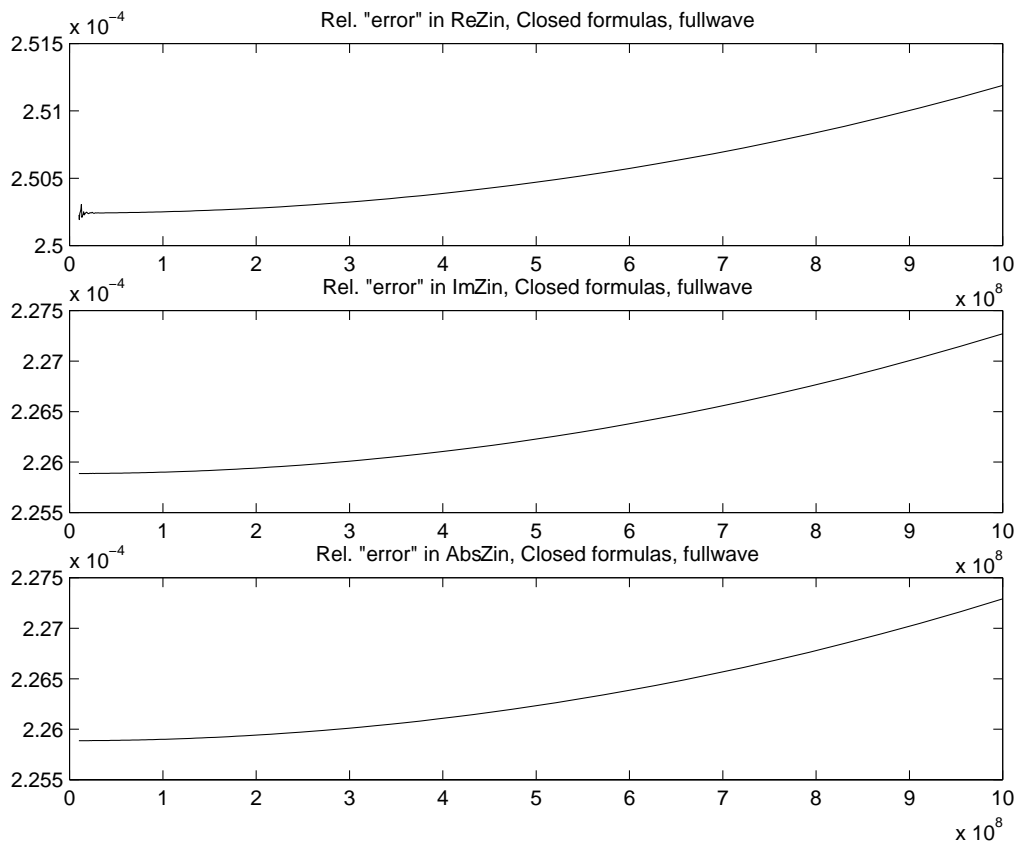
Figure 4: Closed formulas, fullwave, V(1)
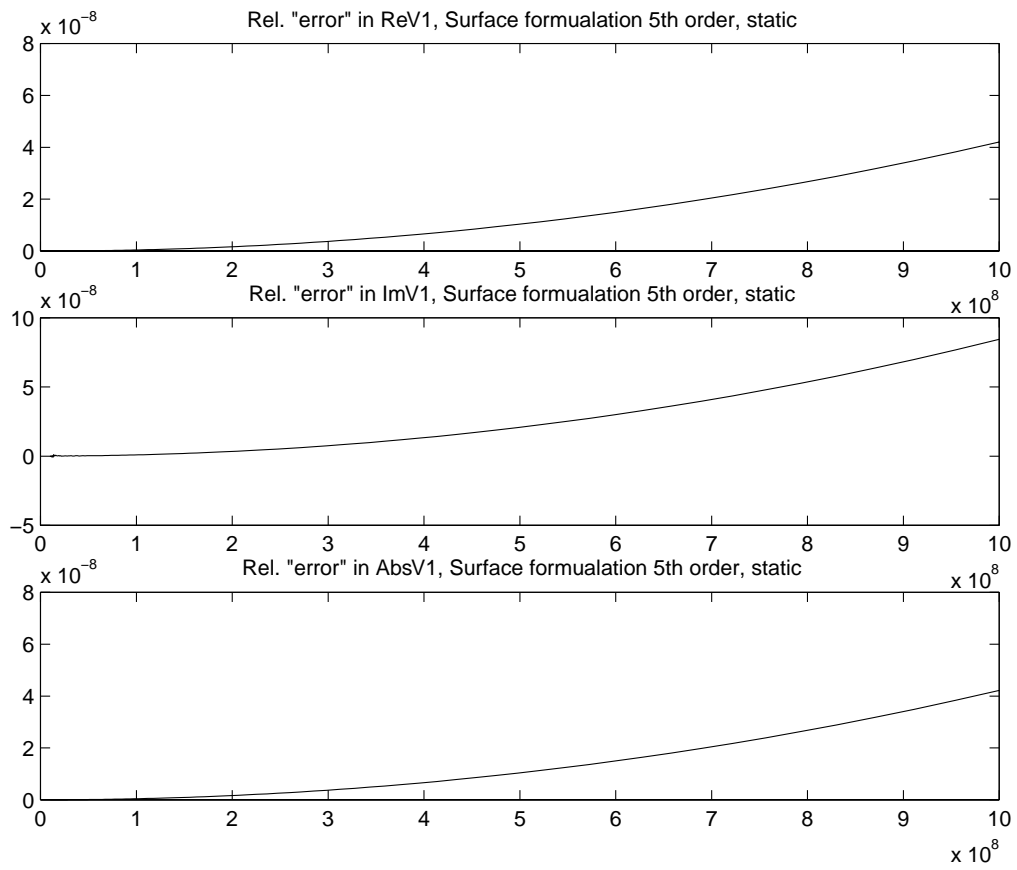
5

Figure 5: Closed formulas, fullwave, Zin

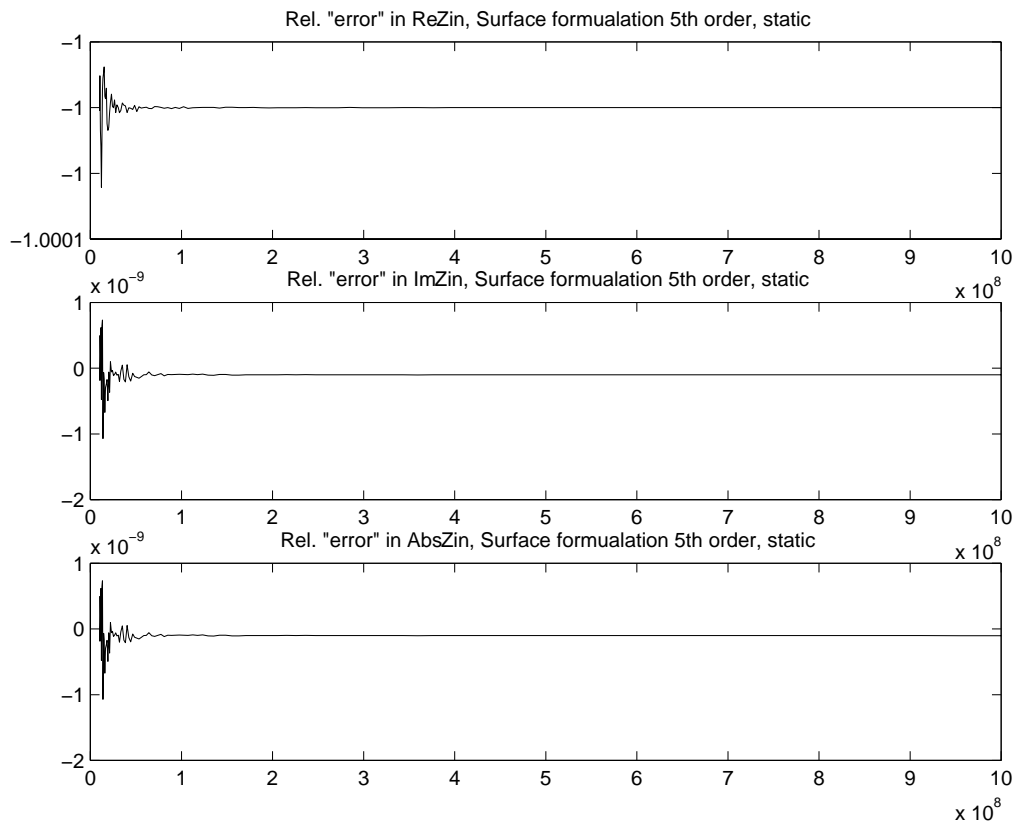Figure 6: Surface form, static, V(1)

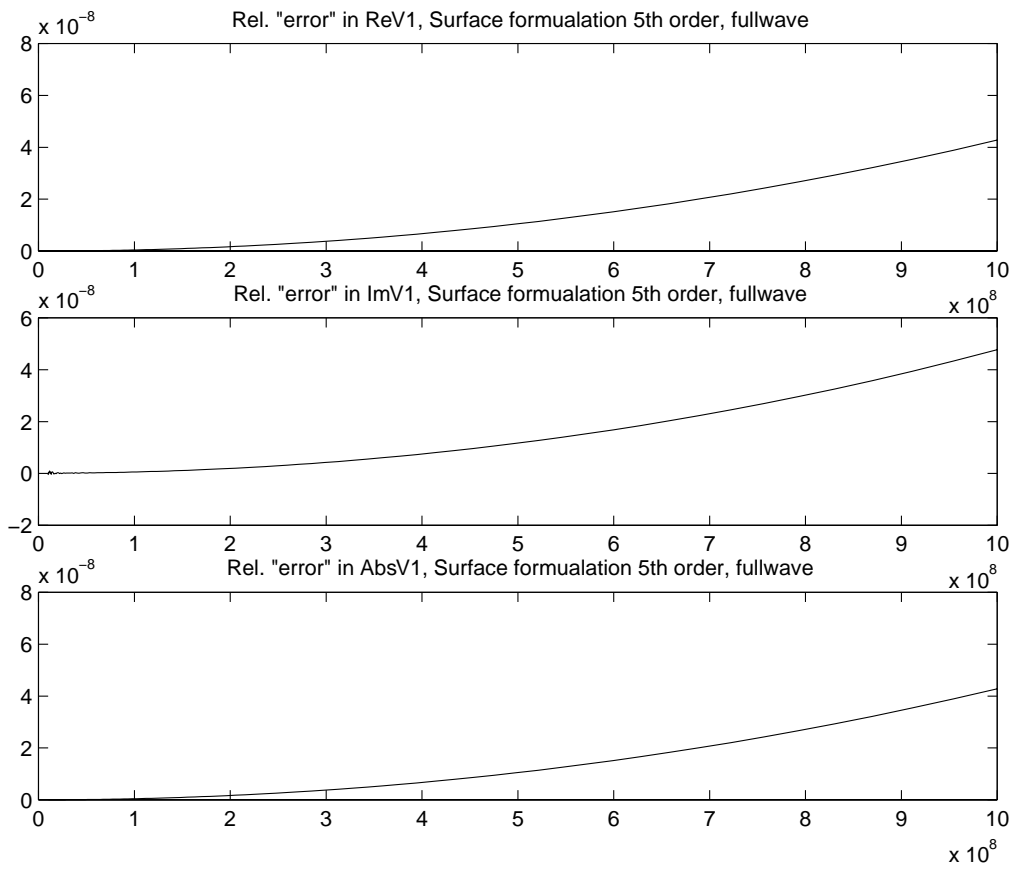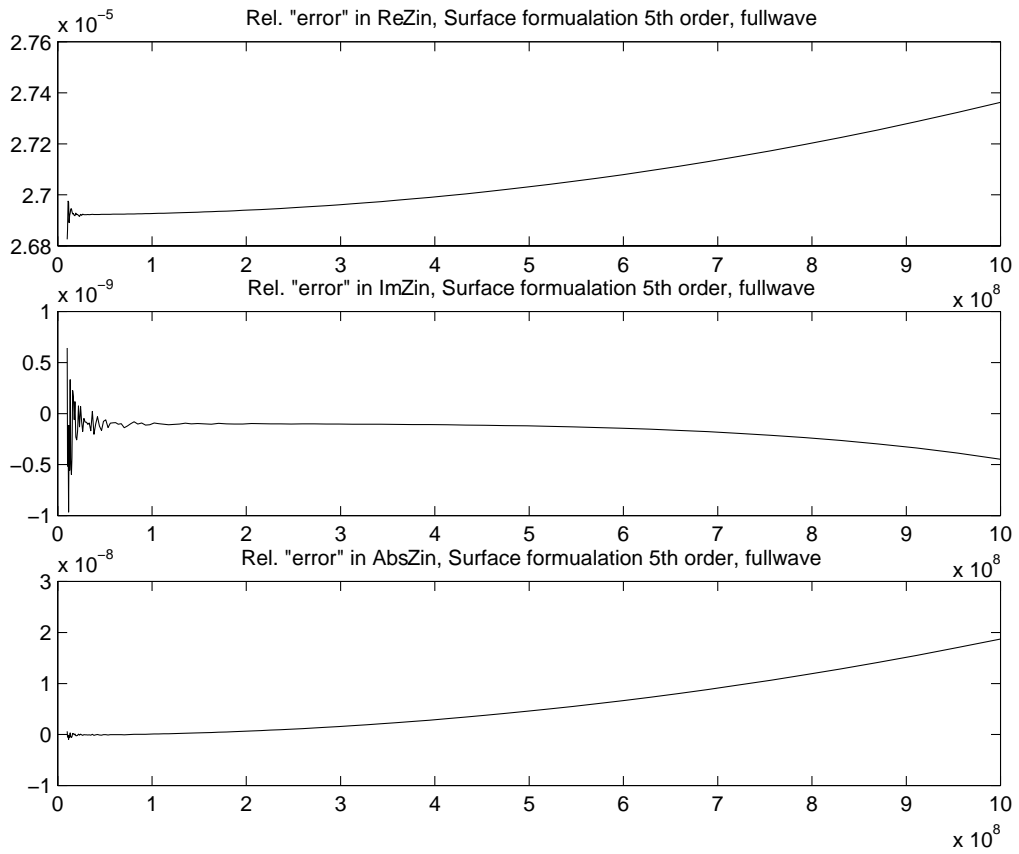Figure 7: Surface form, static, Zin

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Figure 8: Surface form, fullwave, V(1)

Figure 9: Surface form, fullwave, Zin