Comparison – Scale Modelling of a Copper Parabola

As part of a modeling exercise carried out in 2000 at INCO in Sudbury by Ben Polzer, the step response over a copper parabola was measured. In this paper, these data are compared with the response of MultiLoop III. The MultiLoop III data was computed using a mesh with 650 nodes built in Pebble. The quadratic coefficients for the shape of the parabolic mesh were derived from measurements of the scale model.

While the scale model size of the parabola was known, its position relative to the traverse line was not. Accordingly, the location of the parabola in MultiLoop III was shifted so the simulated and modelled cross-overs lay at the same position on the survey line. The parabola was then shifted vertically until the amplitudes matched. Similarly, the surface resistance of the copper was not known, so the resistance was adjusted until a good match in the model and simulated decays were obtained.

As a result, the parabola was determined to lie between stations 40 and 70 (X) on the profile. The simulated model had a Y-extent from -28 to +32, and a Z extent from -16 to -1. The copper was determined to have a surface resistance of 2×10^{-6} Ω. All dimensions used in MultiLoop III were in meters, while the dimensions used in the scale model were in centimeters. (Formatting in MultiLoop III assumes meter+ sized objects.) Because of the scaling, the simulated resistance in MultLoop III was scaled by a factor of 10,000 to determine the surface resistance of the copper. (refer to scaling theory in Grant and West for details). The top of the parabola was located 1 unit below the line.

Results presented here were computed with the *standard* solver residuals and *near* block-relaxation coupling preference options. The smooth basis function option was not used to compute the coupling between the parabola and the system antennae.

The step response of the annulus was measured at 2500 Hz., with channels spaced in 20 equal intervals over each half cycle. The scale model data were archived, and are compared here, using continuous normalization in %. The system geometry is illustrated in Figures 1 and 2, with more details to be found in the archived files.

Results for the annulus are presented in Figures 3 and 4. The scale model data are plotted as points while simulated data are plotted as lines. Agreement with the scale model data is very good; there is an amount of asymmetry in the scale model measurements, and the symmetric response generated by MultiLoop III is usually well within the variation set by the asymmetry. Accordingly, the MultiLoop simulation agrees with the scale model data to experimental error set by the asymmetry.

Files used in this paper are archived in MLPIII Comparison / ScaleModelParabola.

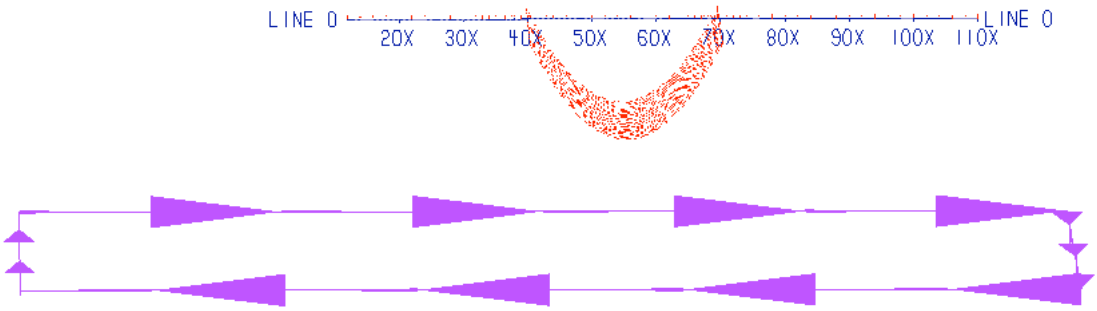

Figure 1: Side view of the simulated model, showing the loop, profile and mesh.

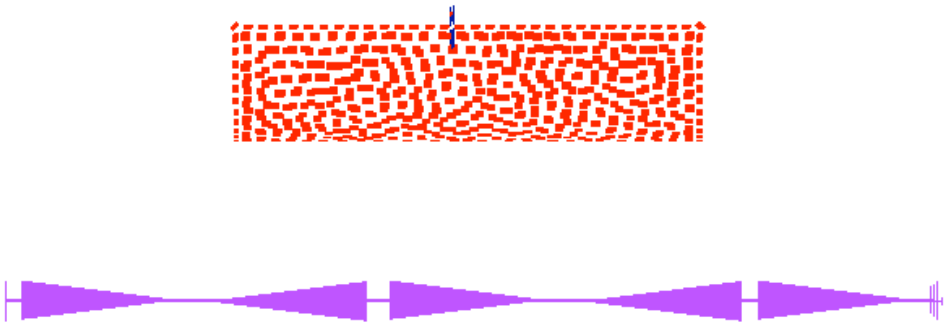

Figure 2: End view of the simulated model, showing the loop, profile and mesh.

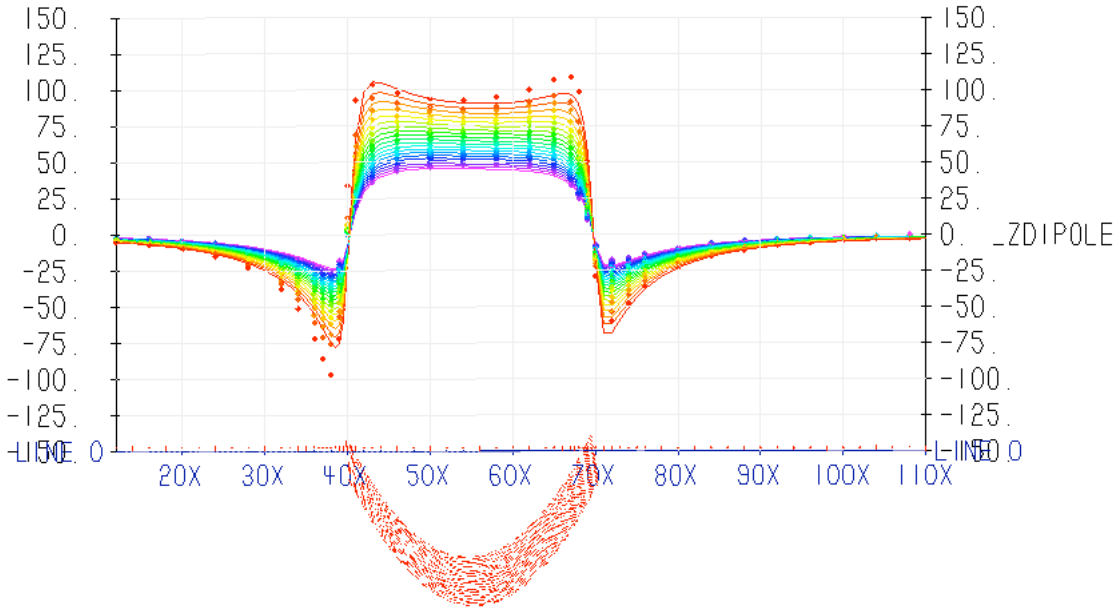

Figure 3: Side view of the simulated model, showing the loop, profile and mesh together with the profile data. The simulated data are plotted using lines, the scale model data using points.

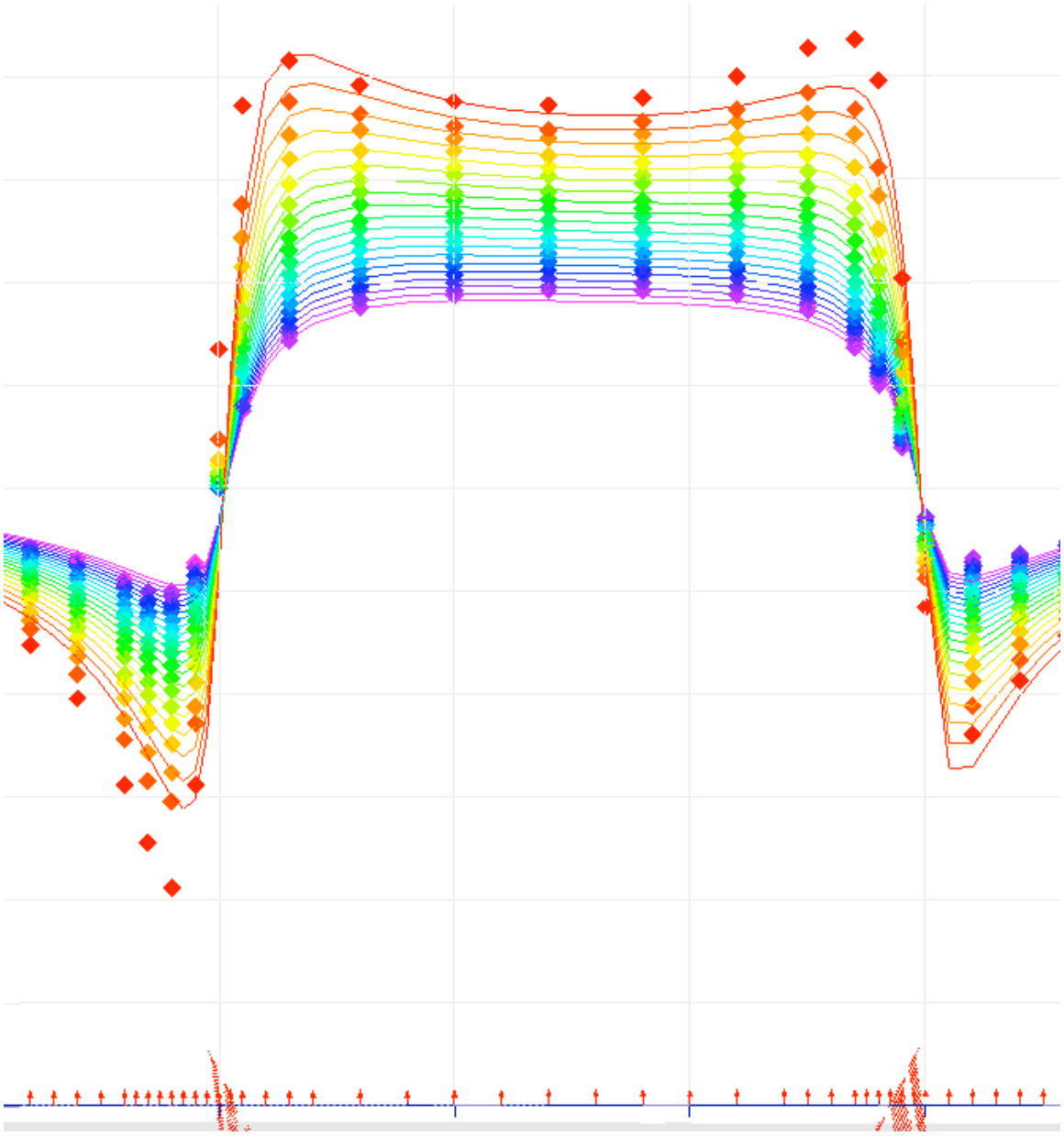

Figure 4: Side view of the simulated model, showing the loop, profile and mesh together with the profile data. The receiver antennae are plotted along the line. The simulated data are plotted using lines, the scale model data using points.