Scope of Work for Laura Connor
Project: 01402.461
Period of Performance: July 10, 2002 to December 30, 2002

Charles B. Connor and Laura Connor have written a computer code to model magnetic field data efficiently using standard forward calculation and optimization methods based on the simplex optimization method. The code is written in ANSI C and uses the message passing interface (MPI). The code runs in parallel to use any number of processors to estimate magnetic anomalies rapidly. Specifically, this code:

a) Calculates the magnetic anomaly due to a set of vertical sided prisms using the forward solution proposed by Rao and Babu (1991, *Geophysics*).

b) Solves for the forward solution at many grid points using parallel programming techniques and the Message Passing Interface.

c) Compares observed and calculated magnetic anomalies using standard goodness-of-fit measures (i.e., chi-squared)

d) Alters parameters (depth to top of prisms, depth to base of prisms, magnetization) using the downhill simplex method in multiple dimensions (Nelder and Meade, 1965, *Computer Journal*, 7: 308). The simplex method is modified to incorporate rule sets specific to magnetic data modeling.

e) Outputs a best-fit model together with calculated solution at each grid point, which may be subsequently visualized using generic mapping tools or similar software.

This code will be modified for use by CNWRA in the following ways:

1) Laura Connor will write a series of subroutines to model magnetic data in the Fourier domain, following the methods of Parker (1977, *Annual Reviews of Earth and Planetary Sciences* 5: 35-64), and Parker and Huestis (1974, *Journal of Geophysical Research* 79: 1587-1593). The revised forward calculation will estimate magnetic anomalies due to a surface consisting of $n_x \times n_y$ grid points, with depth to the top of the surface specified at each grid point. This surface represents the top of a geologic unit having magnetic contrast with the surrounding rock. The forward calculation will be devised so this unit may have constant thickness, constant depth to base, or variable thickness.

2) Laura Connor will integrate these new subroutines into the existing magnetic modeling code. This will involve changing the numbers and types of parameters using in the inversion model. This step will involve some magnetic modeling and model testing for the sole purpose of evaluating the code performance.

3) Assisted by Chuck Connor, Laura Connor will document the modeling code and test the forward models using CNWRA QA procedures. Experience with PVHA codes indicates that at least 1.5 weeks needs to be allocated for this step to meet TOP-18 requirements.

4) Assisted by Chuck Connor, Laura Connor will deliver the complete modeling code to the CNWRA and install this code on a CNWRA system on or about Sept 5–6, 2002. This task will include a complete source code with documentation, and a version of the code compiled to run on a LINUX computer cluster containing MPI software. She also will meet with CNWRA staff for training on the use of the code and to discuss possible modifications related to GUI development and visualization of output.

5) While at the CNWRA, Laura Connor will work with CNWRA staff to model magnetic data collected in the Yucca Mountain region, using geologically reasonable model assumptions.

Laura Connor also agrees that:

i) Charles and Laura Connor hold the copyright on parts of the code that already exist.
ii) The new parts of the code to be developed under contract to CNWRA will be owned by CNWRA. Charles and Laura Connor retrain the right to publish model results using the new code.
iii) Charles and Laura Connor retain the right to model magnetic data for clients independent of CNWRA using magnetic modeling codes not developed under contract with CNWRA.
iv) Charles and Laura Connor retain the right to pursue academic grants (e.g., National Science Foundation, NASA) using magnetic modeling codes developed independent of the CNWRA.

This work will be completed by September 6, 2002. At completion, it is anticipated that the team will be able to evaluate the strengths and weakness of the application for modeling complex anomalies resulting from 3D geologic bodies.

Projected Costs

Personnel:

Task 1: 60 hr @ =
Task 2: 40 hr @ =
Task 3: 60 hr @ =
Task 4: 8 hr @ =
Task 5: 16 hr @ =

Total Personnel Costs:

Direct Expenses:

To be billed at cost. Estimated expenses are currently:

Travel to San Antonio:
Roundtrip airfare Tampa to San Antonio:
Car Rental:
Hotel: 2 nights at /night:
Meals: 2 days @ /day =
Total Direct Expenses:

Total Cost:

for a fixed price of . This is equivalent to 90 hrs work by Ms. Connor at a rate of per hours. This rate includes a base rate of per hour (base) + base) indirect cost (

No travel or additional direct expenses are anticipated. The full amount, , will be invoiced following delivery of the revised PVHA-YM code on CD-ROM.

Ms. Connor may be asked to perform similar tasks on other projects. When these tasks are identified, a scope of work will be developed and a cost for the work developed.