Problem Set #2 - How Fast?

Use time series obtained in Problem Set #1. Solve for rates of motion in the x,y,z and n,e,u components, and their uncertainties. Provide plots that show the model (straight line) that fits the time series best. Provide a table of the rates for this GPS site.

Assignment

Step 1. Do problem set #1.

Step 2. Set up a matrix equation in Matlab by building the ***G*** and ***d*** matrices.

$$\boldsymbol{G}\,\boldsymbol{m}=\boldsymbol{d}$$

where ***d*** contains the data (coordinates) and ***G*** contains the coefficients to the model equation, and ***m*** will contain the two model parameters you are solving for in each time series.

Solve this system for ***m*** using Matlab solving tools or the solution to the overdetermined least squares inversion :

$$\boldsymbol{G}^{-g}=(\boldsymbol{G}^{T}\boldsymbol{G})^{-1}\boldsymbol{G}^{T}$$

$$\boldsymbol{m}_{est}=\boldsymbol{G}^{-g}\boldsymbol{d}$$

You can get the predicted values for the data using the estimated model parameters

$$\boldsymbol{d}_{pred}=\boldsymbol{G}\,\boldsymbol{m}_{est}$$

and the residual is

$$\boldsymbol{r}=\boldsymbol{d}-\boldsymbol{d}_{pred}$$

Step 3. Compute the uncertainties in these model parameter estimates.

$$cov\,\boldsymbol{m}=\boldsymbol{G}^{-g}\,cov\,\boldsymbol{d}\,\boldsymbol{G}^{-gT}$$

Step 4. Make a table that clearly lists the estimated values and their uncertainties (you can use matlab fprintf, do it by hand or whatever). This table should include to covariances when they are non-zero.

What would we have to do if we wanted to include covariance estimates for the rates in the north, east and up directions?

Step 5. Make plots similar to those you made for problem set #1. Except now include a line (in a different color preferably) that represents the model for this time series. Also plot the residual to each model, these time series are called “detrended”.

Is the model a good model?

Would it be better to 1) solve for the rates from north, east, up time series, or 2) solve for rates from x,y,z time series and then convert the rates to north, east, up using a transformation? What is the impact on the estimates of uncertainty?

Step 6.

Email your table, plot files and responses to questions, (preferable all in one file) to *whammond@unr.edu* in some format I can read (.pdf, .ps, Word, Open Office, etc.)