Geophysical Research Abstracts,
Vol. 11, EGU2009-333, 2009
EGU General Assembly 2009


# Non linear Least Squares(Levenberg-Marquardt algorithms) for geodetic adjustment and coordinates transformation.

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The resolution of the MRE's (Multiple Regression Equations) is an important tool for fitting different geodetic network.
Nevertheless, in different fields of engineering and earth science, certain cases need more accuracy; the ordinary least squares (linear least squares) prove to be limited.
Thus, we have to use new numerical methods of resolution that can provide a great efficiency of polynomial modelisation.
In geodesy the accuracy of coordinates determination and network adjustment is very important, that's why instead of being limited to the linear models, we have to apply the non linear least squares resolution for the transformation problem between geodetic systems.
This need, appears especially in the case of Nord-Sahara datum (Algeria), on wich the linear models are not much appropriate, because of the lack of information about the geoid's undulation.
In this paper, we have fixed as main aim, to carry out the importance of using non linear least squares to improve the quality of geodetic adjustment and coordinates transformation and even the extent of his use.
The algorithms carried out concerned the application of two models: three dimensions (global transformation) and the two-dimension one (local transformation) over huge area (Algeria).
We compute coordinates transformation parameters and their Rms by both of the ordinary least squares and new algorithms, then we perform a statistical analysis in order to compare on the one hand between the linear adjustment with its two variants (local and global) and the non linear one.
In this context, a set of 16 benchmark, have been integrated to compute the transformation parameters (3D and 2D).
Different non linear optimization algorithms (Newton algorithm, Steepest Descent, and Levenberg-Marquardt) have been implemented to solve transformation problem.
Conclusions and recommendations are given with respect to the suitability, accuracy and efficiency of each method.

Key words: MRE's, Nord Sahara, global transformation, localtransformation, Steepest Descent, Levenberg-Marquardt,.