Searching for the optimal relationships between SIRGAS2000, SAD69 and Córrego Alegre, in Brazil

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1. Introduction

Brazil adopted SIRGAS2000 in 2005. This fact created the need for establishing relationships with the other 2 frames used in the country: Córrego Alegre (CA) and South American Datum of 1969 (SAD69). Due to the distortion between those frames, the relationships can not be well established with Helmert transformation parameters only.

To solve this problem, 5 Study Groups were created to look for the optimal relationships for coordinate transformation between those frames. The approaches being investigated to augment the parameter transformation are based on: Collocation, Delaunay, Regular grids (NTv2 and Sheppard method) and Neural Networks. The research is currently going on.

2. The methods in a glance

Collocation is based on a simultaneous adjustment and regression model carried out in two steps, where the covariance function is formed based on the residuals of the first step. The basic model reads: $A\delta + Br + \Phi^T\lambda + w = 0$.

Delaunay triangulation is applied to model the local distortions remaining after the geometric model is used, by means of an interpolation approach. In this method it is imposed the condition of uniqueness of results in the direct and inverse transformations.

The Grid solutions are being investigated by two study groups. These approaches are essentially based on modelling the residuals of a geometric (3 or more parameters) transformation. One group is using NTv2, which stands for National Transformation, while the other applies the Sheppard Method, to create the grid. They use a transformation function weighted with respect to distance and/or orientation between a particular point and its neighbours.

A Neural Network approach has been developed, aiming at taking advantage of its self-adaptability, for estimating the distortion between frames, for any location, without the need of using any information besides the point coordinates.
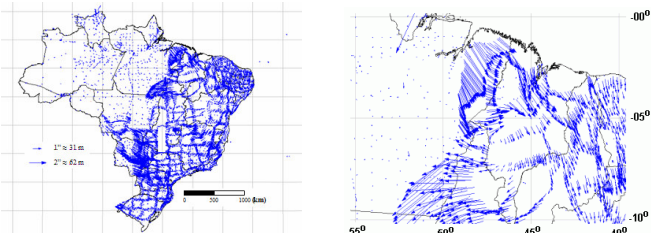

Figure 1 – Map of distortions between SIRGAS2000 and SAD69 (left), and detailed view (right).
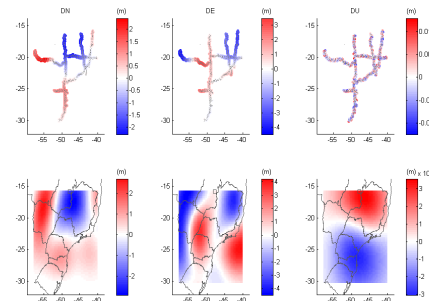

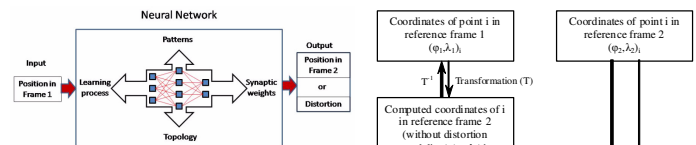Figure 2 – Collocation "residuals" in latitude, longitude and height.
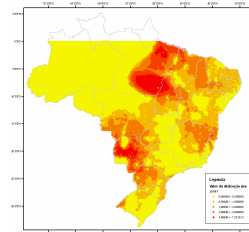

Figure 3 – The Neural Network scheme.

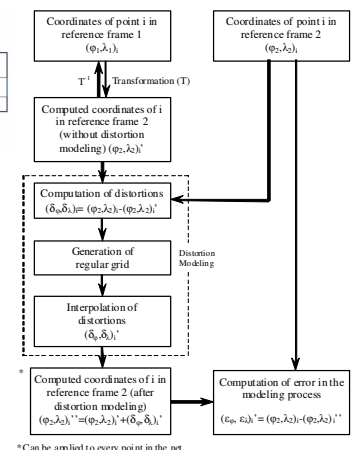Figure 4– Residuals of the NTv2-based solution.

Figure 5 – Flowchart of a "modified NTv2".

Acknowledgments

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