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Efficacy of the Conventional Deformation Analysis Methods for GPS Network

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To monitor plate tectonics, the movement of engineering structures, landslides etc., geodetic control networks as, e.g., conventional vertical, horizontal or 3D networks as well as GPS networks, may be established. It is necessary to control the stability of these networks periodically. The main aim of geodetic deformation measurements is to identify any point displacements in the control networks, and consequently to detect any deformation of the object. It is important to know whether the points detected by Conventional Deformation Analysis (CDA) are really displaced or not, and also if there are any more displaced points in the network. It is impossible to answer these questions unless the actual positions of the displaced points before the analysis are known. There are two reasons for the unsuccessful results of the Conventional Deformation Analysis (CDA) method: 1. the spreading effect of Least Squares Estimation (LSE), 2. the failure of F-test. When a displacement occurs at a point, both the observations that belong to the displaced point and to those undisplaced points closest to it are affected. The LSE spreads these effects to various degrees over all the coordinates. As a result, the actual displacements are not exactly reflected in the coordinates of that point. Consequently, CDA methods may wrongly identify a point as being displaced. Also the F-test is known not to be successful in some cases. To eliminate the smearing effect of the LSE and the indifference of the F-test, in order to obtain more specific results a new strategy has been developed based on division into subnetworks. The observations of the GPS network were simulated and then CDA and new strategy were applied to the simulated networks. The efficacy of CDA method was measured using the Mean Success Rate (MSR). According to the obtained results, the MSRs of the new strategy are higher than the CDA.