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OUTLIER DETECTION IN GPS NETWORKS WITH FUZZY LOGIC AND CONVENTIONAL METHODS

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It is assumed that the geodetic observations always have random errors and these errors are normally distributed. The measurements have random errors that deviate from the normal distribution are called as 'outliers'. Outlier investigation is one of the first interest areas of the statisticians and different approaches have been developed for this purpose so far. In the literature, there isn't a method as the best over all. In the conventional methods like 'Data Snooping (DS)', 'Tau', and 't' tests, outliers are determined iteratively by the statistical test theory and removed from the observation set. In the fuzzy logic approach, fuzzy set relations and the statistical tests are used together to detect the outliers. Fuzzy membership relations are used among the residuals and observation errors. In this study, commonly used conventional methods (statistical tests) and fuzzy logic method have been applied to several GPS networks with different characteristics. It has been aimed to find which algorithm is convenient among the methods used in this study for outlier detection in GPS observations. The baseline components ΔX, ΔY, and ΔZ of the GPS baselines have been taken as the measurements. The conventional methods have been applied to the networks at different significance levels. As the significance level gets greater, the sensitivity of the tests for outlier increases and more outliers appear. It is appropriate to determine the significance level regarding the number of the observations in the network. The capabilities of the fuzzy logic approach to be an alternative method have been examined. Also, it has been seen that the results of this method are completely dependent on the statistical tests. Unlike conventional methods, no measurement is removed from the observation set, thus the shape of the network isn't defected.

CONCLUSIONS AND RECOMMENDATIONS

In GPS networks with redundant observations, choosing the significance level as 0.001 is sufficient to realize outlier detection procedure. Working with great significance levels produces unreliable results. In conventional methods, a normal observation may seem as outlier at the end of iterations and may be removed from observation set. Thus, the shape of the network is defected. On the other hand, more reliable results are obtained with fuzzy logic method. In contrast to the conventional methods, the observations that have test statistics close to the critical value are examined more accurately. It has not any iteration and removal about observations. There is no disadvantage of shape defection of network. The outliers are determined altogether at the end of the method.