**Title**

Quality Assessment of GNSS/IMU derived NAP heights: using RILA and RDNAPTRANS™2018

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**Abstract**

The purpose of this thesis is to do quality assessment of GNSS/IMU derived NAP heights for The Netherlands (NAP) using Fugro RILA technique and the RDNAPTRANS2018 published by Rijkswaterstaat. The use of Global Navigation Satellite System (GNSS) is growing rapidly in order to determine the position (both horizontal and vertical). However, the GNSS is only able to give the geometric height which is the position on the ellipsoid, which have a drawback that the surface of constant ellipsoidal height are not equipotential surface, and hence these heights need to be transformed into traditional height systems such as the Normaal Amsterdam Peil (NAP) used in The Netherlands. In order to derive these NAP heights from the GNSS heights, a (quasi-) geoid model along with corrector surface model is used to convert from one height to another. In this study the newly computed local quasi geoid model NLGEO2018 rather than the NLGEO2008 is adapted using RDNAPTRANS2018 along with Fugro Rail Infrastructure aLignment Acquisition (RILA) technique which makes use of GNSS/IMU to obtain ellipsoidal height. It was found upon using the older transformation procedure RDNAPTRANS2008, which makes use of NLGEO2008, a mismatch in the order of 17mm between the NAP and GNSS-derived NAP from RILA. This error is not only due to the geoid itself but also the systematic errors in the different height system. However, this new geoid NLGEO2018 along with the new transformation procedure of RDNAPTRANS2018 allows a more accurate conversion of ellipsoidal to normal heights and this study focuses on this quality assessment of the new GNSS/IMU derived NAP heights and investigate how well NAP heights be obtained using RILA technique based on the new geoid. It was found with the use of the new geoid and the new transformation model RDNAPTRANS2018, the mean height difference was reduced from 12mm to 3.6mm showing a better fit of GNSS heights to NAP heights. An error budget was also calculated, to understand the reliability of these RILA measurements with the NAP heights. This error budget includes all the uncertainties from all error sources, namely RILA derived height, geoid height and the levelled height, followed by hypothesis testing. The highest uncertainty was from GNSS/IMU measurements from RILA system followed by the levelling and then the gravimetric quasi-geoid. Finally from this analysis, areas where the terrestrial surveying can be avoided was found. It was found that near the stations, tunnels, high vegetation had the highest uncertainty due to poor GNSS reception. It was also found that level crossing also showed a constant systematic offset between the two heights potentially due to the materials of the level crossings.