



## **The new DMT SAFEGUARD low-cost GNSS measuring system and its application in the field of geotechnical deformation and movement monitoring**

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In the recent years an increasing awareness of geodetic measurement systems and their application for monitoring projects is clearly visible. With geodetic sensors it is possible to detect safety-related changes at monitoring objects with high temporal density, high accuracy and in a very reliable manner. Quality acquisitions, processing and storage of monitoring data as well as a professional on-site implementation are the most important requirements and challenges to contemporary systems in civil engineering, mining as well as oil and gas production. Monitoring measures provide important input for early warning, alarm, protection and verification of potential hazardous environments and therefore the risk management applied to projects have a significant influence. The implementation has to follow an optimization process incorporating necessary accuracy, reliability and economic efficiency.

From the economical point of view the costs per observation point are crucial for most monitoring projects. Keeping in mind that the costs of classical high-end GNSS stations with a geodetic dual-frequency receiver is within the range of several 10,000 euro. Large monitoring networks with a high number of simultaneously observed points are very expensive and therefore eventually have to be cut back, substituted by compromising methods or totally withdrawn. A further development in the area of GNSS receivers could reduce this disadvantage. Within the last few years single-frequency receivers that record L1-signals of GPS/GLONASS and offer sub-centimeter positioning accuracies are increasingly offered on the market. The accuracy of GNSS measurements depends on many factors as the hardware itself as well as on external influences related to the measurement principals. The external influences can be strongly reduced or eliminated by appropriate measuring and processing methods. For a reliable monitoring system it is necessary that the results are comparable and consistent for each epoch.

Based on these requirements DMT has developed the new DMT SAFEGUARD GNSS. In this article the latest developments in the field of low-cost GNSS are shown by different examples from industry and authorities. By means of a detailed accuracy study the DMT SAFEGUARD GNSS system applicability will be demonstrated. The study shows possibilities to detect coordinate shifts on sub centimeter level by using suitable data processing approaches and permanent network solutions. In addition to the DMT SAFEGUARD GNSS system this article illustrates the combination with further relevant sensors to integrated multisensorial networks. Such networks include geodetic data, geophysical data, geotechnical data, video, audio etc. For the central integration of all sensor types DMT has developed a web-based monitoring system – DMT SAFEGUARD which offers individual customizing, sophisticated analysis tools as well as comprehensive reporting options.