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Methodology and use of tensor invariants for satellite gravity gradiometry

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Although its use is widespread in several disciplines, the theory of tensor invariants is only marginally adopted in gravity field processing. We aim to close that gap by preparing and applying the invariants approach for potential field recovery. Gravitational tensor invariants are deduced from second order derivatives of the gravitational potential, namely by products between the tensor elements referred to as gravitational gradients (GG). The benefit of the method presented arises from its independence of the gradiometer instrument orientation in space. Thus, we refrain from the classical methods for SGG analysis, namely at the level of single GG components, in favour of the alternative approach.

The invariants approach requires a more complicated kind of processing. Firstly, the non-linear functional with regard to the potential series expansion in spherical harmonics calls for the linearisation and iterative solution of the resulting least-squares problem. Secondly, the deduced pseudo-observations are composed of all the gravitational tensor elements demanding them within a homogeneous accuracy level. Additionally, for its application to huge data sets the implementation of the method is a challenging task.

In the scope of this presentation we show basic fundamentals of tensor invariant theory adopted to the SGG observation configuration. With regard to the satellite mission GOCE (Gravity field and steady-state Ocean Circulation Explorer) we point out adequate solution strategies for the problems mentioned and demonstrate the invariants approach to be a viable alternative for gravity field recovery to conventional methodologies.