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Towards 'Memorable' and Highly Accurate Forward Potential Field Modelling in Space-domain

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Space-domain forward potential field modelling can often be characterised as memory-less, i.e. if the task is to compute a field quantity for an ensemble of points in space, the computations must be done from scratch each time; even if given field points are located in the vicinity of one another and the field itself is smooth. Furthermore, a standard technique is to do such computations using so-called elementary bodies, i.e. the geometrical 3D-bodies (e.g. the homogenous rectangular prisms) for which a closed expression for a 3D-Newtonian integral exists. This limits the class of possible models in a sense that more complex Earth models can only be constructed by introducing a large number of such elementary bodies, thus increasing the computational task. In practise, a number of techniques have been developed to optimise the above inherent limitations of the space-domain methods. For example, the well-known remove-restore technique, where the field effect of the topography or parts of the topography is modelled and removed to smooth the residual field. A smooth residual field is more suitable for interpolation. Other technique is to introduce rougher (and thus fewer) elementary bodies for the distant sources or even to replace them by point masses (which have mathematically simpler field expressions). The present contribution is a first step in the direction of the following scenario. A potential field in a given local area can be pre-computed and stored once for all. For a known source, any field quantity can be represented to an arbitrary degree of accuracy both inside and outside the sources. The task of computating a field quantity in an arbitrary point in space reduces to determining a value of a low degree polynomial associated with the station location using the pre-computed coefficients for a given area. The functional inter-dependence of different field quantities (known from advanced physical geodesy) is preserved and represented by the stored coefficients. The method does not

require any remove-restore type of techniques. Transformation to the global spherical- or ellipsoidal geometry in a local area can easilly be implemented even though the local formulation is Cartesian. The key component of the method is a power series expansion of the reciprocal distance function with respect to the fixed source point and field point. In my talk I will explain how this simple technique can lead to the above scenario and beyond.