Tensor Invariants for Gravitational Curvatures

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The tensor invariants (or invariants of tensors) for gravity gradient tensors (GGT, the second-order derivatives of the gravitational potential (GP)) have the advantage of not changing with the rotation of the corresponding coordinate system, which were widely applied in the study of gravity field (e.g., recovery of global gravity field, geophysical exploration, and gravity matching for navigation and positioning). With the advent of gravitational curvatures (GC, the third-order derivatives of the GP), the new definition of tensor invariants for gravitational curvatures can be proposed. In this contribution, the general expressions for the principal and main invariants of gravitational curvatures (PIGC and MIGC denoted as I and J systems) are presented. Taking the tesseroid, rectangular prism, sphere, and spherical shell as examples, the detailed expressions for the PIGC and MIGC are derived for these elemental mass bodies. Simulated numerical experiments based on these new expressions are performed compared to other gravity field parameters (e.g., GP, gravity vector (GV), GGT, GC, and tensor invariants for the GGT). Numerical results show that the PIGC and MIGC can provide additional information for the GC. Furthermore, the potential applications for the PIGC and MIGC are discussed both in spatial and spectral domains for the gravity field.