Abstract

This thesis explores the gravity and magnetic aspects (functionals) derived from the gravity gradient tensor (GGT) and magnetic gradient tensor (MGT). These functionals include topography, gravity disturbance, GGT components, GGT invariants, strike angle, comb factor, total magnetic field, reduced-to-pole total magnetic field, MGT components, total horizontal gradient, tilt angle, logistic total horizontal gradient, and upward and downward continuation filters.

The primary purpose of this research is to comprehensively identify these versatile functionals and apply them to Earth, the Moon, and Venus, culminating in four peer-reviewed papers.

1. Lunar Water-Bearing Locations:
The analysis of gravity aspects, particularly strike angles, reveal potential water-bearing locations in the lunar polar regions, indicating areas with liquid and ice water deposits. These findings are crucial for future lunar exploration and habitat development, especially concerning the process of Impact gardening.
2. **Comparative Analysis of Earth and Venus**:
Given the similar gravitational properties of the Earth and Venus, the application of the gravity functionals- including topography, GGT components, strike angle, comb factor and GGT invariants- unravel differences in subduction features, deformation levels, complex volcanic processes, and mantle plumes on the two planets.
3. Impact Structure in Badain Jaran Desert:
The investigation of the potential field functionals, including free air and Bouguer gravity anomalies, GGT and MGT components, total horizontal gradient, logistic total horizontal gradient, strike angle, comb factor, magnetic field, and its reduced-to-pole transformation, supports the existence of a buried impact structure in Badain Jaran Desert, northwest China. This structure is characterized by annual gravity heights, preferred parallel directions, and magnetic anomalies indicative of shock waves and magnetization patterns, providing insights into impact crater identification and regional geological processes
4. Depth Estimation of Anomalous Bodies:
The application of gravity aspects, such as gravity disturbance, GGT components and invariants, offers a novel method for estimating the depth of underground anomalous bodies with varied dimensions. This method provides horizontal location and depth estimates based on the relative variations in the horizontal extent of the causative body, accommodating different body types and depths. Testing on lunar data and various model scenarios demonstrates method's effectiveness, suggesting its applicability inn both planetary and engineering contexts.