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Regularisation of the action and its non-uniqueness in the Euclidean teleparallel gravity

We investigate the regularization of the Euclidean gravitational action in the teleparallel equivalent of general relativity (TEGR), where the action is dynamically equivalent to that of GR but depends on both the tetrad and an undetermined spin connection. We evaluate the action using both bulk and quasi-local surface integrals across three frames: proper, canonical, and a newly introduced Euclidean free-falling frame. While all yield finite action, the results differ, revealing a fundamental non-uniqueness. In particular, the Euclidean free-falling frame admits an infinite family of inequivalent finite action solutions, raising important questions about the interpretation and regularization of gravitational actions in teleparallel geometry.

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