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Special coordinate systems in pseudo-Finsler geometry and the equivalence principle

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Abstract

Special coordinate systems are constructed in a neighborhood of a point or of a curve. Taylor expansions can then be easily inferred for the metric, the connection, or the Finsler Lagrangian in terms of curvature invariants. These coordinates circumvent the difficulties of the normal and Fermi coordinates in Finsler geometry, which in general are not sufficiently differentiable. They are obtained applying the usual constructions to the pullback of a horizontally torsionless connection. The results so obtained are easily specialized to the Berwald or Chern-Rund connections and have application in the study of the equivalence principle in Finslerian extensions of general relativity. *2010 MSC:* 53B40; 58B20

Keywords: Finsler geometry, normal coordinates, equivalence principle.

1 Introduction

Finslerian modifications of Einstein's gravity have received renewed attention quite recently [6, 11, 14, 17, 22, 24, 25, 33], while the mathematical interest in Finsler geometry never faded [5, 7–9, 21, 34]. In these theories the motion of a free falling particle is described by a geodesic, this concept being defined through the notion of spray [35]. As such it makes no reference to other properties of the particle such as its mass or its composition. We might say that the weak equivalence principle is naturally satisfied in these theories.

Still one would like to show that any free falling observer looking at neighboring free falling particles observes them moving uniformly over straight lines, at least within some approximation. In order to accomplish this result it is

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