1040-70-234   **Kurt M. Ehlers*** (`Kmehlers@smcm.edu`), Mathematics Department, St. Mary's College of Maryland, 18952 E. Fisher Rd., St. Mary's City, MD 20686, and **Jair Koiller** (`jkoiller@fgv.br`), Praia de Botafogo 190, Rio de Janeiro, 22253-900, Brazil. *Mechanical systems with rolling constraints, invariants and symmetries.*

For natural Lagrangians L = T-V, where we take V = 0 for simplicity, the trajectories of a mechanical system with nonholonomic constraints are geodesics of a (non-metric) connection which mimics Levi-Civita's. This point of view was introduced by E. Cartan in an address to the International Congress of Mathematicians at Bologna in 1928. In his address Cartan proposed a program for answering the natural questions motivated by Klein's Erlangen program: what are the local symmetries and invariants of the corresponding geometry? Cartan made some progress in the simplest case, systems with two-step constraint distributions. We discuss our progress in carrying on Cartan's program. In particular, we discuss the symmetries and invariants of mechanical systems with constraint distributions having growth vector (2,3,5) which include classical systems such as the Chaplygin ball. (Received February 28, 2008)