

ABSTRACT

On the Dynamical Propagation of Subvolumes and on the Geometry and
Variational Principles of Nonholonomic Systems

by

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There are two main themes of this thesis. The first is the theory and application of the propagation of subvolumes in dynamical systems. We discuss the integral invariants of Poincaré-Cartan and introduce a new and closely related set of integral invariants, those of Wirtinger type, and relate these new invariants to a minimum obtainable symplectic volume. We will then consider the application of this approach to the orbit determination and correlation problem for tracking particles of space debris. The second theme is on the geometry of nonholonomic systems. In particular we will focus on the precise geometric understanding of quasi-velocity techniques and its relation to the formulation of variational principles for these systems. We will relate the Euler-Poincaré equations for Lie groups to the Boltzmann-Hamel equations and further extend both these equations to a higher order form that is applicable to optimal dynamical control problems on manifolds.