

# NORMAL FORMS FOR NEAR RELATIVE EQUILIBRIA

**Cristina Stoica**

Department of Mathematics and Statistics  
Wilfrid Laurier University  
Waterloo, ON, Canada, N2L 3C5  
cstoica@wlu.ca

## **Abstract**

The symplectic slice theorem states the existence of a local parametrisation of the phase-space of Lie symmetric of cotangent-bundle systems in which the canonical form of the Meyer-Marsden-Weinstein reduced space is “embedded” in the canonical form of the unreduced space. Unfortunately, this theorem is not constructive, and so it cannot be applied to specific systems.

For free and proper actions, we present an iterative method for generating the changes of coordinates map from the original phase-space to the symplectic slice parametrisation. In this way, we obtain coordinates suitable for the application of the Birkhoff-Poincaré normal forms method near a relative equilibrium. These coordinates allow, in particular, the study of symmetric systems near a relative equilibrium with symmetry-breaking perturbations.

In the case of  $SO(3)$ -invariant systems, we obtain the change of coordinates map explicitly. We discuss our parametrization in relation to the classical regularized Serret-Andoyer-Deprit coordinates for rigid body motion and describe applications to more general systems.