

Averaged Dynamics via Averaged Lagrangians

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Abstract

Suppose we have a mechanical system whose dynamics are governed by a Lagrangian function together with Hamilton's variational principle. How does one go about constructing an *averaged* Lagrangian for the system? In what sense will this averaged Lagrangian give the averaged dynamics of the system? We provide a new, concrete procedure for constructing an averaged Lagrangian. The equations of motion resulting from this new Lagrangian will retain geometric structures inherent in the original mechanical system. We compare our method to other methods for constructing averaged Lagrangians: methods developed by Andrews and McIntyre, Gjaja and Holm, and Marsden and Shkoller. In doing so, we describe the first steps towards a theoretical foundation for all dynamical methods/theories of averaging.