Meeting: 1006, Lubbock, Texas, SS 11A, Special Session on Future Directions in Mathematical Systems and Control Theory

1006-93-185 **Sanjeeva D. H. Maithripala*** (sanjeeva.maithripala@ttu.edu), **Jordan M Berg** and **Wijesuriya P Dayawansa**. *Almost-Global Tracking of Simple Mechanical Systems on a General Class of Lie Groups.*

We present a general intrinsic tracking controller design for fully-actuated simple mechanical systems, when the configuration space is one of a general class of Lie groups. We first express a state-feedback controller in terms of a function–the "error function"– satisfying certain regularity conditions. If an error function can be found, then a general smooth and bounded reference trajectory may be tracked asymptotically from almost every initial condition, with locally exponential convergence. Error functions may be shown to exist on any compact Lie group, or any Lie group diffeomorphic to the product of a compact Lie group and $\mathcal{R}^n$. We show here that for compact Lie groups the dynamic configuration-feedback controller obtained by composing the full state-feedback law with an exponentially convergent velocity observer is also almost-globally asymptotically stable with respect to the tracking error. For the special case where the kinetic energy is left-invariant, we show that the explicit expression of these controllers do not require coordinates on the Lie group. The controller constructions are demonstrated on $SO(3)$, and simulated for the axi-symmetric top. Results show excellent performance. (Received February 14, 2005)