Passivity-based Velocity Tracking and Formation Control Without Velocity Measurements

Ningbo Li, * **Jacquelien M. A. Scherpen,** * **Arjan van der Schaft,** *
Pablo Borja, * **Robert Mahony** **

* *Jan C. Willems Center for Systems and Control, University of Groningen,*
The Netherlands (e-mail: ningbo.li@rug.nl, j.m.a.scherpen@rug.nl,
a.j.van.der.schaft@rug.nl and l.p.borja.rosales@rug.nl).
** *College of Engineering and Computer Science, Australian National*
University (e-mail: robert.mahony@anu.edu.au).

Abstract: This abstract proposes a passivity-based control method for velocity tracking and formation control of nonholonomic wheeled robots without velocity measurements. Coordinate transformations are used to incorporate the nonholonomic constraints, which are then avoided by controlling the front end of the robot rather than the center of the wheel axle into the differential equations. Starting from the passivity-based coordination design, the control goals are achieved via an internal controller for velocity tracking and heading and an external controller for formation in the port-Hamiltonian framework, leading to a clear physical interpretation. To avoid the unavailable velocity measurements or unreliable velocity estimates, we derive the distributed control law with only position measurements by introducing the idea of dynamic extension. Simulations are provided to illustrate the effectiveness of the approach.

Keywords: Passivity, wheeled robots, port-Hamiltonian, nonholonomic constraints