Recursive properties of Dirac and metriplectic Dirac brackets with applications

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Abstract: In this article, we prove that Dirac brackets for Hamiltonian and non-Hamiltonian constrained systems can be derived recursively. We then study the applicability of that formulation in analysis of some interesting physical models. Particular attention is paid to the feasibility of implementation code for Dirac brackets in Computer Algebra System. © 2008 Elsevier B.V. All rights reserved.

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References:

• Marsden, J.E., Ratiu, T.S., (1994) Introduction to Mechanics and Symmetries, , Springer, Heidelberg

• Dirac, P.A.M., Generalized Hamiltonian mechanics (1950) Canad. J. Math., 2, p. 129

• Dirac, P.A.M., Generalized Hamiltonian mechanics (1950) Proc. Roy. Soc. London A, 246, p. 326

• Dirac, P.A.M., Generalized Hamiltonian mechanics (1964) Lecture Notes on Quantum Mechanics, , Yeshiva Univ., NY

• Flato, M., Lichnerowicz, A., Sternheimer, D., Deformations of Poisson brackets, Dirac brackets and applications (1976) J. Math. Phys., 17 (9), pp. 1754-1762

• Śniatycki, J., Dirac brackets in geometric dynamics (1974) Annales de l'Inst. Henri Poincaré, XX (4), pp. 365-372

• Bhaskara, K.H., Viswanath, K., (1988) Pitman Reseach Notes in Math, 174. , Longman Sci

• Schouten, J.A., On the differential operators of first order in tensor calculus (1954) Conv. Int. Geom. Diff. Roma Cremanese

• Vaisman, I., (1994) Progress in Math., 118. , Birkhäuser, Basel

• Xu, P., Dirac submanifolds and Poisson involutions (2003) Ann. Sci. Ecole Norm. Sup., 36 (4), pp. 403-430. , Preprint available at: math.SG/0110326

• Crainic, M., Fernandes, R.L., Integrability of Poisson brackets (2004) J. Diff. Geom., 66 (1), pp. 71-137

• Marciniak, K., Błaszak, M., Geometric reduction of Hamiltonian systems (2005) Rep. Math. Phys., 55, pp. 325-339

• Langer, J.S., Turski, Ł.A., Hydrodynamic model of the condensation of a vapor near its critical point (1973) Phys. Rev. A, 8, pp. 3230-3243

• Enz, C.P., Turski, Ł.A., The Fokker-Planck equation for compressible liquids (1979) Physica A, 96, p. 369

• Morrison, P.J., A paradigm for joined Hamiltonian and dissipative dynamics (1986) Physica D, 18, pp. 410-419

• Nguyen, Q.H.S., Turski, Ł.A., On Dirac approach to constrained dissipative dynamics (2001) J. Phys. A, 34, pp. 9281-9302. , See related reference therein

• Tanner, H.W.L., A theorem relating to Pfaffians (1878) Messenger Math., 8, pp. 56-59

• Knuth, D., Overlapping Pfaffians (1996) Electron. J. Combin., 3, pp. 151-163. , Preprint available at: math.co/9503234

• Vein, R., Dale, P., (1999) Appl. Math. Scie., 134, pp. 46-50. , Springer-Verlag, New York

• Hu, G.Y., O'Connell, R.F., Analytical inversion of symmetric tridiagonal matrices (1996) J. Phys. A, 29, pp. 1511-1513

• Badler, N.I., Phillips, C.B., Webber, D.L., (1999) Simulations humans. Computer graphics, animation and control, , Oxford University Press

• Maurer, C., Peterke, R.J., A new interpretation of spontaneous sway measure based on a simple model of human posture control (2005) J. Neurophysiol., 93, p. 189

• Leuk, M., Chow, C.C., Pavliik, A.E., Collins, J.J., Human balance out of the equilibrium: Nonequilibrium statistical mechanics in posture control (1998) Phys. Rev. Lett., 80, p. 413

• Nguyen, Q.H.S., Turski, Ł.A., Canonical description of incompressible fluid: Dirac brackets approach (1999) Physica A, 272, pp. 48-55

• Fixman, M., Classical statistical mechanics of constraints: A theorem and application (1974) Proc. Natl. Acad. Sci. USA, 71 (8), pp. 3050-3053

• Turski, Ł.A., On the hydrodynamics of desorbing adsorbate (1983) Phys. Rev. A, 28, p. 2548. , See related reference therein