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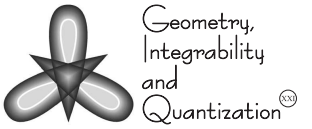

SYMMETRIES AND CONSERVATION LAWS OF A SYSTEM OF TIMOSHENKO BEAM TYPE WITH SMOOTH COEFFICIENTS

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Abstract. Recently Yoon, Ru and Mioduchowski have introduced a model based on the classical Timoshenko beam theory, describing the propagation of transverse waves in double-wall carbon nanotubes regarded as a system of two separate nested tubes interacting via van der Waals forces. In the present work, we study the group properties of a system of equations generalizing the governing equations of the aforementioned model in which some of the coefficients are assumed to depend on the spatial variable. The full group consisting of all local point one parameter smooth automorphisms admitted by the regarded system is established. Next, the subgroup of those of them that leave invariant the functional whose Fréchet gradient (Euler-Lagrange equations) is exactly the regarded system of equations is obtained. Finally, all conservation laws bijective to the set of the divergence symmetries of the foregoing functional are determined.

Keywords: Conservation laws, divergence symmetries, group analysis, Lie algebras, Lie groups, variational statement

1. Introduction

In 2004, Yoon, Ru and Mioduchowski [8] suggested a model of Timoshenko beam type describing small transverse in-plane vibration of a double-wall carbon nanotube (DWCNT) regarded as a system of two separate nested nanotubes interacting through van der Waals forces. The system of equations of motion derived within their model consists of four second-order linear partial differential equations of constant coefficients in two independent variables (a spatial one and the time) and four dependent variables. This system of equations was studied in [8, 9], with the