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Erratum

Geometrically Exact, Intrinsic Theory for Dynamics of Curved and Twisted Anisotropic Beams

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IN [1] a set of governing equations was derived for the geometrically exact dynamics of an initially curved and twisted anisotropic beam. A fully intrinsic formulation is devoid of displacement and rotation variables, making them especially attractive because of the absence of singularities, infinite-degree nonlinearities, and other undesirable baggage associated with finite rotation variables. Though not applicable to all problems involving beam analysis, they were applied in fully intrinsic form to the aeroelasticity of HALE aircraft in the computer code NATASHA (Nonlinear Aeroelastic Trim and Stability Analysis of HALE Aircraft) [2,3]. The purpose of this Erratum is to correct an unintended impression that may be rightfully inferred from [1]: that, by virtue of the *absence of certain references*, the notion of writing fully intrinsic governing equations for the dynamics of beams originated with the author. It did not.

In fact, the notion of fully intrinsic governing equations for beams goes back nearly three decades before the publication of [1]. The oldest formulation of this type known to the author is that of Hegemier and Nair [4], cited in [5] but not in [1]; the failure of this author to cite the work was inexcusable, because this work was most certainly known to him at the time. Hegemier and Nair present a complete set of fully intrinsic equations for the dynamics of transversely isotropic beams undergoing extension, bending, and torsion. This type of formulation is characterized by partial differential equations of motion and kinematical equations, with unknowns including stress resultants, generalized strains (i.e., 1-D extension, torsion, and bending measures), and generalized velocities (i.e., 1-D velocity and angular velocity measures). Although no solutions are presented, the authors do discuss application of their formulation. In doing so, they introduce orientation angles, which may be needed for some problems; although displacement variables are not introduced, they too may be needed for some problems. The paper does not mention the possibility of using the equations in fully intrinsic form to solve problems.

The main distinction of this type of formulation on which this Erratum is focused is the partial differential kinematical equations that are devoid of displacement or orientation measures. They may also be thought of as space–time compatibility equations, such as Eqs. (13) and (16) of [1] and Eqs. (63) and (64) of [4].

One of the applications mentioned in [4] is the mechanics of cables. It is interesting that this type of formulation also shows up in the more recent literature on mechanics of cables (see, for example, [6–14]). None of these works were cited in [1]. Another published application of a fully intrinsic formulation is found in the robotics literature [15].

The following conclusions are offered: First, the author has been unable to find any papers pertinent to this discussion that are older than [4]. Second, the author has been unable to find a citation to [4] in the more recent literature [6–15]. Third, [1] appears to be unique in offering a geometrically exact, fully intrinsic, dynamic formulation including shear deformation. Finally, of all the works cited herein, only [1] explicitly suggests the use of the fully intrinsic equations for a dynamic formulation without their being augmented with at least some form of angular displacement parameters such as orientation angles. It should be noted, however, that a fully intrinsic formulation has been used for static equilibrium behavior of statically determinate beams (see, for example, [16]).

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