merely a procedure which aided in efficient computation of the results. The method has long been used in the area of structural mechanics. The finite element method as applied to problems in solid mechanics has similar general solution procedure as that of the stiffness method. One obvious difference is that the stiffness matrix method uses the exact solutions for displacements as the interpolation functions.

To comment on any matter unrelated to our paper in this closure is beyond the scope and standards of this journal. However, I would like to point out that it is not uncommon for students to extend basic concepts and techniques obtained from classes to enhance their research work. In fact, graduate courses are purposely designed to help students to develop the necessary background in their field of research. Nonetheless, the principal author would like to thank Dr. Pindera for introducing some of the basic uses of the stiffness method in his elasticity course.

The Motion of a Sphere on a Rough Horizontal Plane

L. Y. Bahar. This paper suffers from a number of stylistic as well as technical deficiencies, which should have been avoided by the joint effort of the writer and the reviewers. It should therefore be read with caution, in my opinion.

1 Stylistically: Under subheading 2, line 2 should read "... nutates and precesses" instead of "... nutates and proceeds," and the sentence after Eq. (1) should read "... precession, nutation and spin" instead of "... precession, nutation and rotation." In the last paragraph of subheading 3, in line 7, "... rotation" should be replaced by "... spin." and in lines 9 and 12 of the same paragraph, as well as in lines 4 and 6 of the last paragraph of subheading 4, the word "... variance" should be replaced by "... variation." The word variance has a precise meaning in statistics and does not convey the one intended in the paper.

Also, the references are not fully documented. The Journal references of the first two due to Chaplygin are not given, also the date of the first reference should be 1897 and 1987! Interested readers will find the details of both of these references given in Neimark and Fufaev (1972) which is not cited. The references do not contain any information about the languages in which the articles have been written originally, including whether the translations into English are available.

2 Technically: This problem has been completely solved by utilizing Euler's equations of motion with respect to axes of fixed orientation (and not moving axes) which is a reference frame where they assume a particularly simple form, because they become linear in the Cartesian coordinates describing the motion of the center of the sphere. This is because the moments of inertia of a sphere are identical with respect to any orthogonal system of axes passing through its center, which suggests that the simplest choice of a reference frame to use is a space-fixed or inertial frame. It is therefore not surprising that the complete solution to this problem which can be found in recent reprints of such classics as Lamb (1990), Loney (1988), and Routh (1960), as well as more recent texts by Ramsey (1937), Smart (1951), Appell (1953), Atkin (1959), Charlton (1963), Easthope (1964), and Chester (1979) formulate it in rectangular Cartesian coordinates. The same is true of the research literature exemplified by Holden and King (1990), in which rolling resistance is added to the usual features.

As seen from all the above references, the choice of an inertial frame in rectangular coordinates uncouples the rotational equations of motion in the angular velocities and reduces the problem to the well-known two-dimensional rotational equations of motion around each of the coordinate axes, on account of spherical symmetry.

A sphere is not a top, and quantities that have particular physical significance for a top such as precession, nutation, and spin have no meaning for a sphere. In addition, they complicate the formulation of the problem by producing nonlinear equations of motion unnecessarily, simply as a result of not taking spherical symmetry into account.

The author's assertion to the effect that "It seems unusual that these solutions are periodic, because under the conditions of friction, it is generally believed that these solutions are decayed" should have indicated that his solution was not physically feasible, despite his experimental observations!

References


Author's Closure

First of all, I would like to express my gratitude to Professor Bahar for his comments. I have to say that some of his remarks, particularly on the paper's style and reference documents, are correct.

On the technical side, I would like to provide Professor Bahar with some information: My other paper, "The Motion of a Sphere With Weak Nutation on a Rough Horizontal Plane," which is currently being reviewed by Associate Editor Professor Inman, gives a solution to a sphere with weak nutation. This proves that the solutions presented in my paper are correct.

Professor Bahar quoted many references, and it seems to indicate that the velocity of center and the velocity of contact point has already been solved by others. Even so, the solutions in my paper differ somewhat from the others. By comparison, we can see the differences are striking.

I don't agree with Professor Bahar's comments that precession, nutation, and spin are meaningless for a sphere. Just rotate (or spin) a glass ball (which is often a children's toy)