Institute of Mechanics – BAS Joint Seminar

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A report "***Mechanics of infinitesimal gyroscopes and infinitesimal affine bodies in non-Euclidean spaces***" was presented by **Assistant Prof. Vasyl Kovalchuk, D.Sc.** from **Institute of Fundamental Technological Research, Polish Academy of Sciences**.

Presentation

The speaker made a long presentation covering detail explanation of the following questions:

- A connection between concepts of extended gyroscopes and affine bodies in Euclidean spaces and infinitesimal gyroscopes and affine bodies in non-Euclidian spaces.
- General scheme of a procedure for affine motion in non-Euclidean spaces: kinematics and canonical formalism, deformation tensors, d'Alembert mechanics and additional constraints imposed on the dynamics of the internal degrees of freedom.
- Most specific idea of description of those two objects in some Riemannian spaces with the use of some pre-established, fixed once for all fields of linear orthonormal aholonomic reference frames and co-frames.
- Special case of infinitesimal gyroscopes and affine bodies moving on the two-dimensional surface of the Mylar balloon that illustrates the general scheme.

Discussion

Prof. V. Vassilev questioned about a formula containing – *X*, *Y* and an arrow that he think express a normal affine space. He asked what tangent space was taken, *X* space or *Y* space.

D.Sc. V. Kovalchuk answered that we have a linear space of translations in the physical affine space *M* and the manifold of linear frames in it. Then if we have the configurations given by the pairs (point *x*, frame *e* attached at *x*), we can expand translations (or free vectors denoted by those arrows) from the point *x* (the centre of mass) to any point *y* (the current spatial position of some material point in our extended body) in the affine space *M* with respect to this frame *e*. We can see that the coefficients of this expansion give us the Lagrange (reference) coordinates of the material point (its identification labels) placed at the spatial point *y*. In this way we can obtain also the analytical description of affine constraints for the extended affinely-rigid body with respect to some Cartesian coordinates in *M*. So, here we have only manifold of frames, not tangent variables.

Assoc. Prof. V. Penev asked if it is possible to apply quaternion approach to define translational and rotational motion; he asked also for some practical examples and is this theory applicable for measuring angular velocity of a big body.

D.Sc. V. Kovalchuk answered that this description can be physically applied to some systems containing any continuous media with a curved surface and defined some material points with central masses and internal properties injected into the tangent space. For example, we can try to describe in this way the motion of icebergs on the sea surface or some crude oil or petroleum spots appearing after some accidents with tankers and cargo ships, etc.

Secretary of the Joint Seminar in IMech-BAS,
Assoc. Prof. R. Krastev