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ROLLING RESISTANCE MODELLING IN THE CELTIC STONE DYNAMICS

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Summary: Aim of the present work is to exhibit a certain approach in constructing reduced models of resulting contact forces occurring on a contact area between an ellipsoidal body and planar surface, with emphasis put on rolling resistance model. Modelling concerns a certain class of problems, where one can assume fully developed sliding on a contact area resulting in relative motion in vicinity of the contact being planar motion of rigid bodies. Resultant friction action is reduced to the friction force and moment acting at the center of finite contact area. Their models are based on the integral expressions under assumption of classical Coulomb's friction law valid at each point of the contact zone. In order to obtain higher simulation speed, special class of approximations is used, being some kind of generalization of Padé expansion. Friction forces are coupled with rolling resistance via contact pressure distribution in one mathematical model. It is assumed simplified model of pressure distribution, that is Hertzian model, which is then modified (distorted) in a special way in order to take into account the rolling resistance. The model is tested numerically and experimentally by the use a special rigid body, that is a Celtic stone, also known a wobblestone or rattleback. Dynamics of the celt is investigated with a special attention paid to the role played by the rolling resistance.