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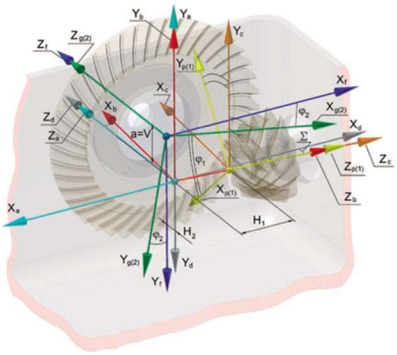
GEOMETRICAL PROBLEMS IN CAD/CAM/CAE PRACTICE BY THE EXAMPLE OF THE MACHINING PROCESS MODELING OF SPIRAL BEVEL GEARS

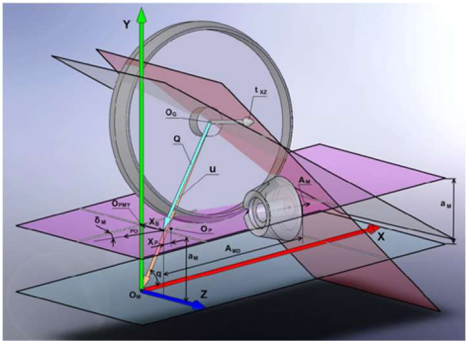
Keywords: *spiral bevel gear, modeling, machining, geometric accuracy, CAD/CAM/CAE.*

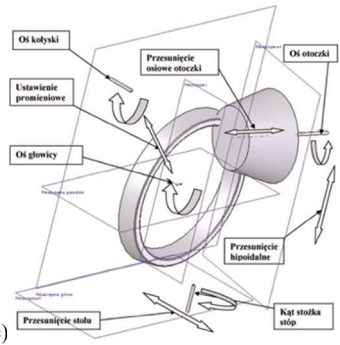
In the fast-paced progress of computer techniques the geometrical problems have become of particular importance in the practice of CAD/CAM/CEA. It concerns surface and solid modeling in the aspect of correct geometry. The definition of curves in accordance with the structural assumptions determines the correctness of the shape of a solid or surface. This translates into the quality of the geometry of the object, which is identical to the geometric accuracy of the model. In the field of machine design a significant example of modeling with application of the CAD/CAM/CAE methodology is a spiral bevel gear with curvilinear tooth line. To make a bevel gear wheel model are required the geometry of the gear wheel body and the key element of the model, which is the surface of inter-teeth space, composed of the convex (drive side) and concave (coast side) surfaces and the surface of bottom land. The surface of inter-teeth space is representation of the tool geometry, milling machine settings and kinematics of the cutting process. The surface of inter-teeth space, thereby tooth model can be obtained in two ways in the case of spiral bevel gear with an arc-shaped tooth. Namely, there are two methods of modeling the machining of bevel gear wheels, using a discrete mathematical model and a solid model. The first method, based on the use of the vector and matrix calculations, maps the geometry and kinematics of the machining process by the mathematical relationships valid in the corresponding coordinate systems configuration (Fig.1 a, b). These form a mathematical model of the gear teeth [1], [3], [7] based on the kinematic theory of envelope proposed by F. V. Litvin [1]. The second method (solid model) involves simulations of teeth machining in CAD/CAE system based on data obtained in construction and technological

calculations (Fig.1 c) and consists in successively performing subtraction logic operations between the workpiece bodies and the tool [4], [5], [6], [8].



a) b)





c)

Fig. 1 a) Configuration of the coordinate system that constitutes the model of the actual construction gear [5],
b) Spatial configuration of the reference system and vectors of the operating quantities of the CNC milling machine [7],
c) Technological shaping system (virtual technological machine) [8]

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