

**UNCONVENTIONAL BEARINGS IN ROTATING MACHINES -
MODELING AND SELECTED APPLICATIONS**

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ABSTRACT

A development of new technologies and more and more numerous applications of non-conventional materials to machine design allow one to consider the idea of building new types of bearings designed especially for high speed turbomachines. This paper shows a classification of rotating machinery bearings with respect to various criteria. These are a few types of bearings, which employ a principle of operation that is not typical for the given application range selected. They are defined as “unconventional” bearings system in turbomachines.

One of the basic problems connected with a practical application of “unconventional” bearings is the machine operational reliability under various working conditions. Therefore, one should analyze thoroughly the dynamics of the rotor-bearing-casing system in the whole operating range of the machine.

Different modeling theories of such bearing dynamic characteristics are shortly described and an example of the nonlinear method algorithm and its solution for the aerodynamic tilting pad gas bearing is shown. In the summary, a trial to determine current design tendency in rotor support systems of low and medium power rotating machinery are presented. Selected examples of unconventional bearing applications in industrial machines are also presented.

Outline of the invited lecture to be delivered at the ISCORMA symposium

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Outline

1. *Introduction – classification of rotating machinery bearings with respect to various criteria.*

Criteria:

- ⇒ *working medium (liquid, gas,)*
- ⇒ *principle of operation (hydrostatic, hydrodynamic, mixed, aerostatic, aerodynamic, roller, magnetic bearings, etc.)*
- ⇒ *geometry (constant, variable)*
- ⇒ *operating parameters (e.g. high-speed, low-speed, turbulent etc.)*

2. *Definition of basic notions, especially of an unconventional bearing.*

- ⇒ *Employing a principle of operation that is not typical of a given application range but should have a specified performance or structural goal and must satisfy the performance assumptions.*

3. *Presentation of principles of operation of bearings defined as unconventional bearing systems in rotary machines.*

- ⇒ *gas aerostatic and aerodynamic bearings*
- ⇒ *hydrostatic bearings*
- ⇒ *active magnetic bearings*

4. *Modeling the bearing dynamic characteristics – linear theory and non-linear theory*

Linear theory:

- ⇒ *quadrature and direct dynamic stiffness*
- ⇒ *direct and coupled dynamic coefficients*
- ⇒ *coupled impedance method*

Non-linear theory:

- ⇒ *an example of the algorithm and its solution for an aerodynamic tilting pad gas bearing*

5. *Application of both the modeling methods in engineering computations of rotor dynamics.*

A short presentation of application of the above mentioned modeling theories in engineering calculations.

6. *Selected examples of applications of unconventional bearing systems in rotating machinery design.*

A short presentation of some examples of application of unconventional bearings in rotating machinery design.

7. *Summary and trial to determine current design tendencies in rotor support systems of low and medium-power rotating machinery.*