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Magneto-Thermo-Mechanical Analysis of Electromagnetic Devices Using the Finite Element Method

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Abstract : Fundamental basics of pure and applied research in the area of magneto-thermo-mechanical numerical analysis and design of innovative electromagnetic devices (modern induction heaters, novel thermoelastic actuators, rotating electrical machines, induction cookers, electrophysical devices) are elaborated. Thus, mathematical models of magneto-thermo-mechanical processes in electromagnetic devices taking into account main interactions of interrelated phenomena are developed. In addition, graphical representation of coupled (multiphysics) phenomena under consideration is proposed. Besides, numerical techniques for nonlinear problems solution are developed. On this base, effective numerical algorithms for solution of actual problems of practical interest are proposed, validated and implemented in applied 2D and 3D computer codes developed. Many applied problems of practical interest regarding modern electrical engineering devices are numerically solved. Investigations of the influences of various interrelated physical phenomena (temperature dependences of material properties, thermal radiation, conditions of convective heat transfer, contact phenomena, etc.) on the accuracy of the electromagnetic, thermal and structural analyses are conducted. Important practical recommendations on the choice of rational structures, materials and operation modes of electromagnetic devices under consideration are proposed and implemented in industry.

Keywords : electromagnetic devices, multiphysics, numerical analysis, simulation and design
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