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Global optimization methods and techniques in Engineering design

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Traditional gradient based optimization methods and techniques are still most widely used tools in engineering design. However, the nature of the real world engineering design problems cannot be often well covered by traditional techniques due to precence of integer and discrete variables, a number of local extremes, multiple optimality criteria, etc. Global optimization methods (GOM) and techniques have property to escape the local extreme and have a better global perspective than the traditional gradient based methods. GOM allow to omit computing derivatives. The cost needed to pay for more powerfull methods is fact that the GOM manipulate with population instead of single solution leading to time consuming numerous evaluations of objective functions. Most commonly the meta-models are utilized for reducinhg computational cost. Continuous improvement of GOM methods and tools, One key issue is decomposition of complex engineering design problems into simpler sub-tasks leading as rule to reduction of complexity and computing time. In the current study are covered hierarchical multi-criteria optimization algorithms and procedures developed by workgroup for solving wide class of practical and theoretical engineering design problems like design of smart composites with structural health monitoring capabilities, design of a slotless permanent magnet generator for wind turbine, design of car frontal protection system, optimal material orientations problems for linear elastic 3D orthotropic materials, etc. These solutions are optimized taking account the features of particular problems, combining GOM tools (hybrid methods, etc.) , utilizing meta-modelling techniques (in most cases artifial neural networks).

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