15th INTERNATIONAL CONFERENCE
Dynamical Systems — Theory and Applications
December 2-5, 2019. Lodz, POLAND.

DSTA 2019

paper id: OPT92

Ggeometry optimization of aeroelastic energy harvester

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Abstract: Geometry optimization was performed using a genetic algorithm (GA) that processes data from CFD calculations. This algorithm generated a random population of ten-arm geometrical figures. Each geometry was subjected to a numerical experiment during which its movement in a fluid-filled channel was simulated and resultant force acting on body was calculated. The calculations were repeated for angular orientation of the object varying from 0 to 358˚, every 2˚, in order to obtain a complete characteristic describing aerodynamical forces acting on body related to its angular orientation. For each of the obtained functions, satisfaction of Dan Hertog's criterion is examined, which is the basis for geometry evaluation. In order to accelerate the calculations, classical GA has been modified by completely eliminating the random factors in favor of operations determined through chaotic processes — in this case, a logistic map. The numerical calculations was carried by method of fundamental solutions. It was chosen due to the fact that for particular geometries the distribution of boundary and source points will change to a relatively small extent, so a large part of the calculations could be carried out before the optimization procedure starts and during the optimization only load proper results.

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