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Explorative gradient method for active drag reduction of the fluidic pinball and slanted Ahmed body YIQING LI, Institute for Turbulence-Noise-Vibration Interaction and Control, Harbin Institute of Technology, Shenzhen, ZHIGANG YANG, Shanghai Automotive Wind Tunnel Center, Tongji University, MAREK MORYNSKI, Chair of Virtual Engineering, Poznan University of Technology, BERND NOACK, Institute for Turbulence-Noise-Vibration Interaction and Control, Harbin Institute of Technology, Shenzhen — We address a challenge of active flow control: the optimization of many actuation parameters guaranteeing fast convergence and avoiding suboptimal local minima. This challenge is addressed by a new optimizer, called explorative gradient method (EGM). EGM alternatively performs one exploitive downhill simplex step and an explorative Latin hypercube sampling iteration. Thus, the convergence rate of a gradient based method is guaranteed while, at the same time, better minima are explored. For an analytical multi-modal test function, EGM is shown to significantly outperform the downhill simplex method, the random restart variant, Latin hypercube sampling, Monte Carlo iterations and the genetic algorithm. EGM is applied to minimize the net drag power of the two-dimensional fluidic pinball benchmark with three cylinder rotations as actuation parameters. The net drag power is reduced by 42 %, owing to Coanda forcing for boat-tailing and partial stabilization of vortex shedding. EGM is also used to minimize drag of the slanted Ahmed body employing distributed steady blowing with 10 inputs. 17 % drag reduction is achieved by inward-directed blowing at all trailing edges emulating boat tailing.

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