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Optimal Design of Submersible Permanent Magnet Linear Synchronous Motor Based Design of Experiment and Genetic Algorithm

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Abstract : Submersible permanent magnet linear synchronous motors (SPMLSMs) are electromagnetic devices, which can directly drive plunger pump to obtain the crude oil. Those motors have been gradually applied in oil fields due to high thrust force density and high efficiency. Since the force performance closely depends on the concrete structural parameters, the seven different structural parameters are investigated in detail. This paper presents an optimum design of an SPMLSM to minimize the detent force and maximize the thrust by using design of experiment (DOE) and genetic algorithm (GA). The three significant structural parameters (air-gap length, slot width, pole-arc coefficient) are separately screened using 27 1/16 fractional factorial design (FFD) to investigate the significant effect of seven parameters used in this research on the force performance. Response surface methodology (RSM) is well adapted to make analytical model of thrust and detent force with constraints of corresponding significant parameters and enable objective function to be easily created, respectively. GA is performed as a searching tool to search for the Pareto-optimal solutions. By finite element analysis, the proposed PMLSM shows merits in improving thrust and reducing the detent force dramatically.

Keywords : optimization, force performance, design of experiment (DOE), genetic algorithm (GA)
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