Minimization of Fuel Consumption in Cyclic and Non-Cyclic Natural Gas Transmission Networks: Assessment of Genetic Algorithm Optimization Method as an Alternative to Non-Sequential Dynamic Programming

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Abstract

For minimization of fuel consumption of natural gas transmission networks, non-sequential dynamic programming (NDP) method guarantees to find the global optimal solution, however NDP method can not be used for analysis of cyclic networks in which the flow rate values are not known in priori. Therefore modified NDP method is proposed in this paper which is capable of being applied to the cyclic network problems. Still a drawback remains with the proposed modified NDP which is impractical computing time except for simple cyclic networks. To solve this basic problem, the Genetic Algorithm (GA) method was selected as an alternative method. Then the modified NDP and GA methods were applied to three types of natural gas transmission network problems including linear, branched and cyclic structures and their results were analyzed and compared. The results showed that for three mentioned network structures, the difference values in objective function (rate of fuel consumption) which were obtained from NDP and GA methods were within acceptable range of 0%-0.55%. Furthermore, it was observed that while the computing time required by the NDP method exponentially depended on pressure and flow rate step sizes, the GA computing time didn't show such a dependency on these parameters.

Keywords: Cyclic and non-cyclic natural gas transmission networks; Optimization of fuel consumption; Non-sequential dynamic programming; Genetic algorithm

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