10th AIAA/ISSMO Multidisciplinary Analysis and Optimization Conference
30 August -1 September 2004, Albany, New York

Effects of Dynamic Penalty Parameters on the Convergence of MOGA in Optimization of a Large Gas Pipeline Network

Kamal K. Botros*, Daniel J. Sennhauser†
NOVA Research and Technology Center, Calgary, Alberta, Canada, T2E 7K7
and
Krystyna Jungowski‡, Gene Poissant§, Hossein Golshan**, Jeff Stoffregen††
TransCanada PipeLines Limited, Calgary, Alberta, Canada, T2P 5H1

Abstract

This paper presents a method based on varying the dynamic penalty function in a Multi-Objective Genetic Algorithm (MOGA) scheme to optimize the operational targets of a large gas pipeline network based on minimum compressor fuel consumption, within boundaries of upper and lower linepack over a broad range of system throughputs. The network contains 22 compressor stations and 54 decision variables resulting in an optimization space of 1.85x1078 cases. The GA calls a hydraulic/thermal model of the pipeline network as well as a detailed station model where the compressor characteristics of each unit are taken into account to define the possible operating point without violating constraints such as surge and stonewall limits, maximum and minimum speeds, and maximum power available. It was found that for such large network systems, penalty parameters needed to be adjusted during the optimization runs to achieve uniform distribution of the targets along the Pareto fronts. The paper discusses the approach taken to arrive at optimal values for these parameters and presents examples for two-objective optimizations (Pareto fronts) to maximize throughput and minimize fuel consumption.

* Research Fellow, Fluid Dynamics, 2928-16 Street N.E., Calgary, Alberta, Canada, T2E 7K7.
† Research Engineer, Fluid Dynamics, 2928-16 Street N.E., Calgary, Alberta, Canada, T2E 7K7.
‡ Senior Engineer, System Design and Operations, 450-1st Street S.W., Calgary, Alberta, Canada, T2P 5H1.
§ Senior Engineer, System Design and Operations, 450-1st Street S.W., Calgary, Alberta, Canada, T2P 5H1.
** Senior Engineer, System Design and Operations, 450-1st Street S.W., Calgary, Alberta, Canada, T2P 5H1.
†† Senior Engineer, System Design and Operations, 450-1st Street S.W., Calgary, Alberta, Canada, T2P 5H1.