Deconstructing Multi-objective Evolutionary Algorithms: An Iterative Analysis on the Permutation Flow-Shop Problem

Supplementary Material

Leonardo C. T. Bezerra, Manuel López-Ibáñez, and Thomas Stützle

IRIDIA, CoDE, Universit Libre de Bruxelles, Brussels, Belgium
{lteonaci,manuel.lopez-ibanez,stuetzle}@ulb.ac.be

Abstract. Many studies in the literature have applied multi-objective evolutionary algorithms (MOEAs) to multi-objective combinatorial optimization problems. Few of them analyze the actual contribution of the basic algorithmic components of MOEAs. These components include the underlying EA structure, the fitness and diversity operators, and their policy for maintaining the population. In this paper, we compare seven MOEAs from the literature on three bi-objective and one tri-objective variants of the permutation flowshop problem. The overall best and worst performing MOEAs are then used for an iterative analysis, where each of the main components of these algorithms is analyzed to determine their contribution to the algorithms' performance. Results confirm some previous knowledge on MOEAs, but also provide new insights. Concretely, some components only work well when simultaneously used. Furthermore, a new best-performing algorithm was discovered for one of the problem variants by replacing the diversity component of the best performing algorithm (NSGA-II) with the diversity component from PAES.

List of Figures

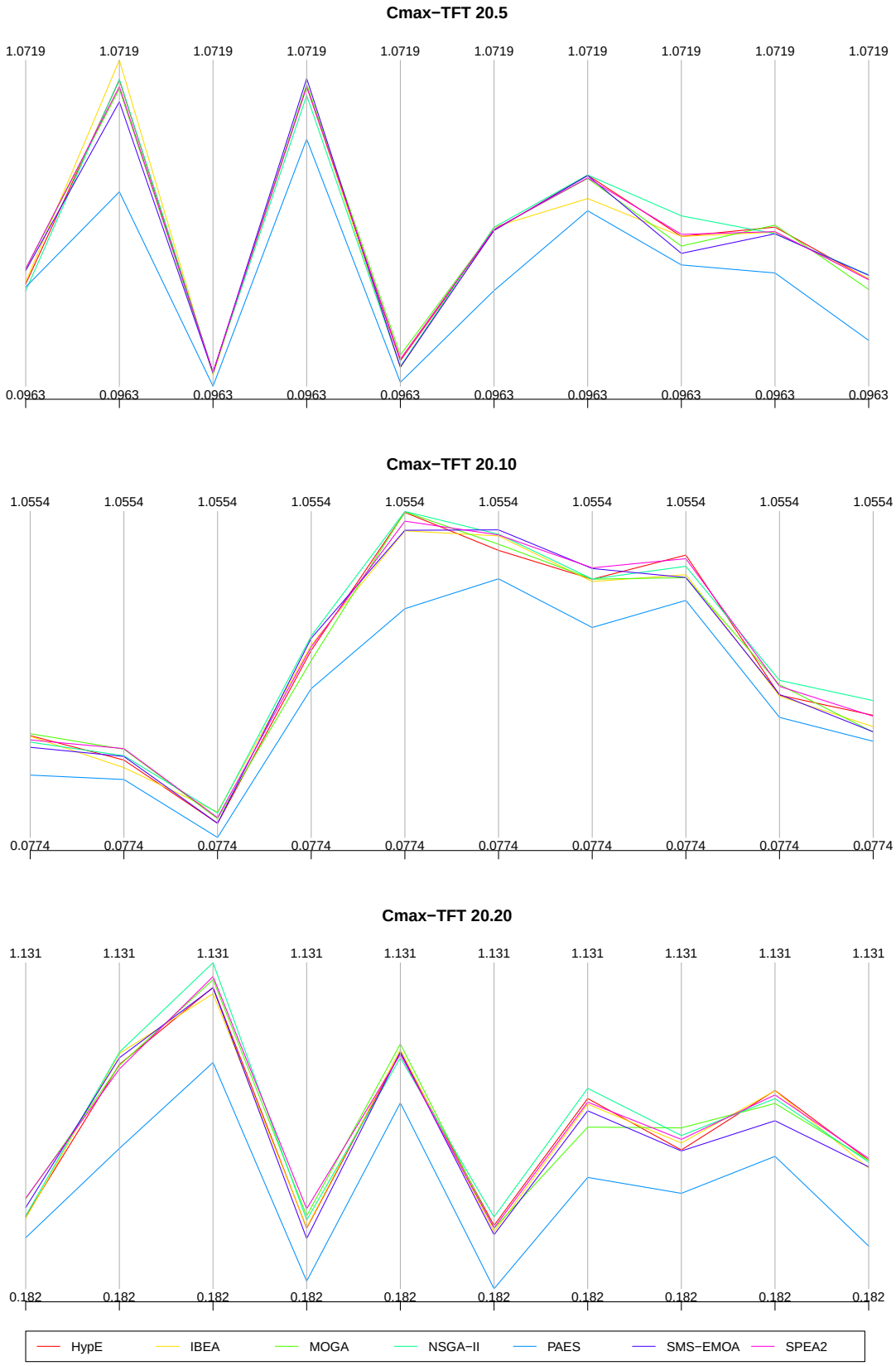

Fig. 1: Average hypervolume over 10 runs on 10 instances with 20 jobs each of Cmax-TFT.

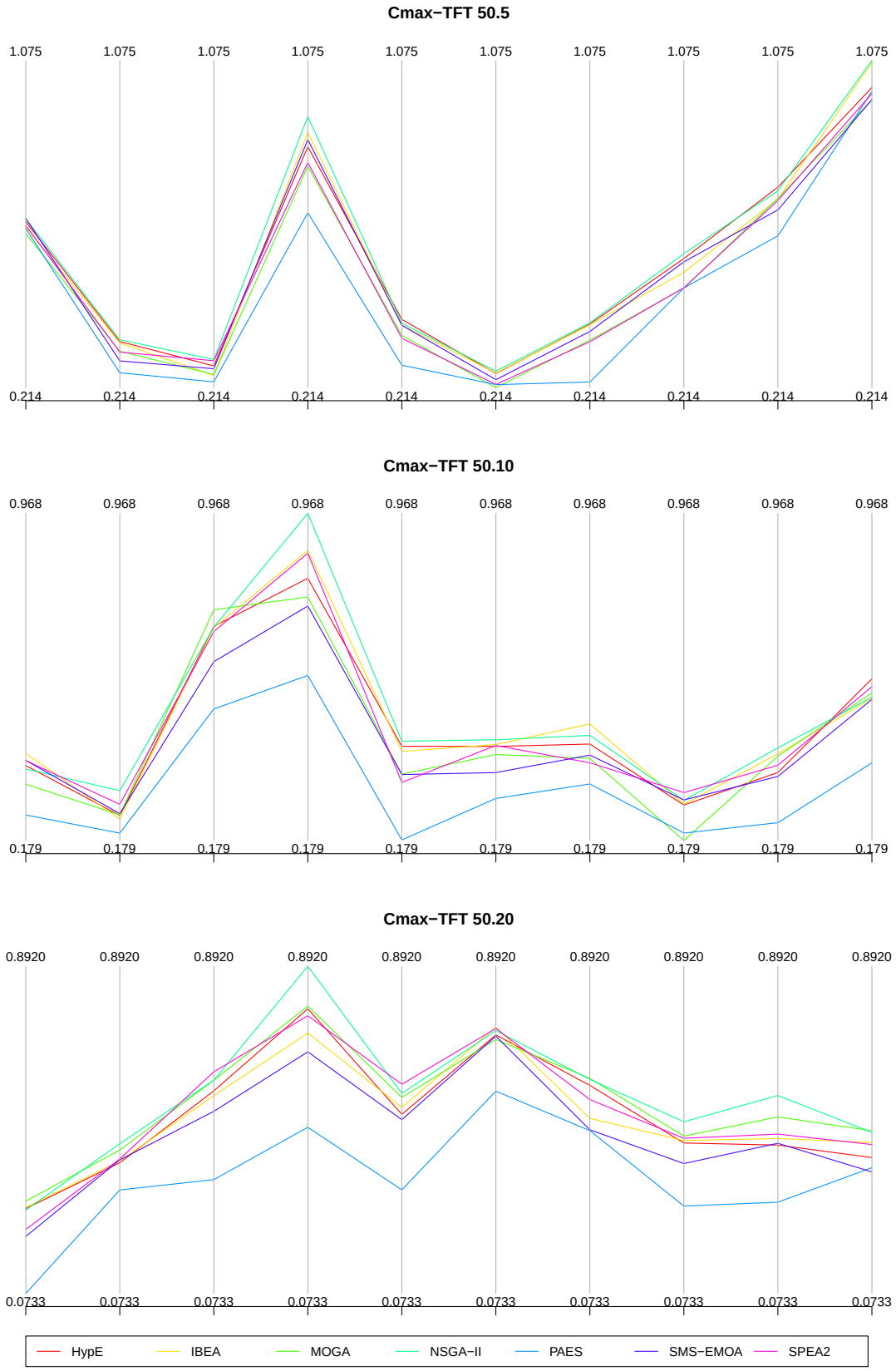

Fig. 2: Average hypervolume over 10 runs on 10 instances with 50 jobs each of Cmax-TFT.

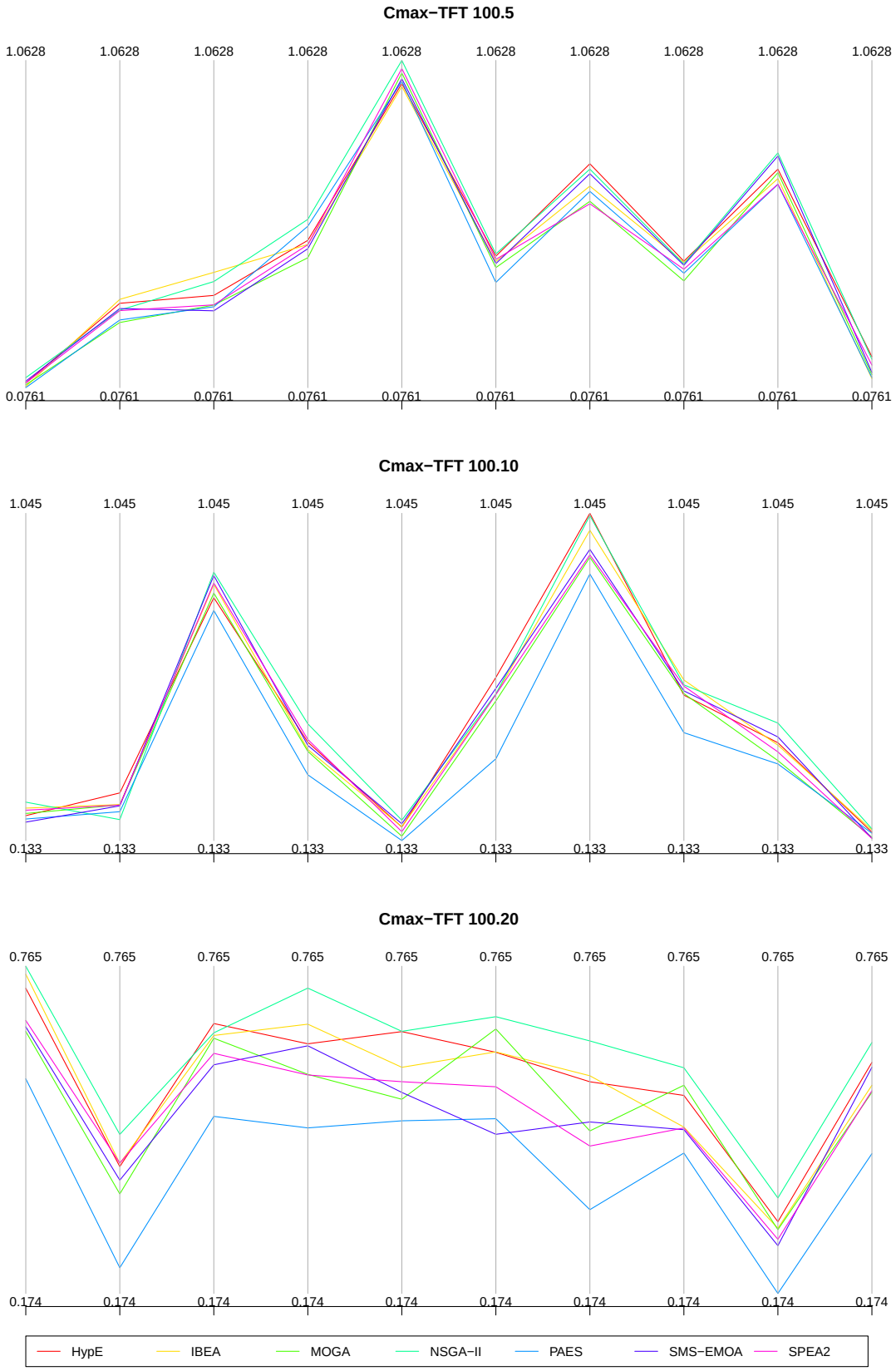

Fig. 3: Average hypervolume over 10 runs on 10 instances with 100 jobs each of Cmax-TFT.

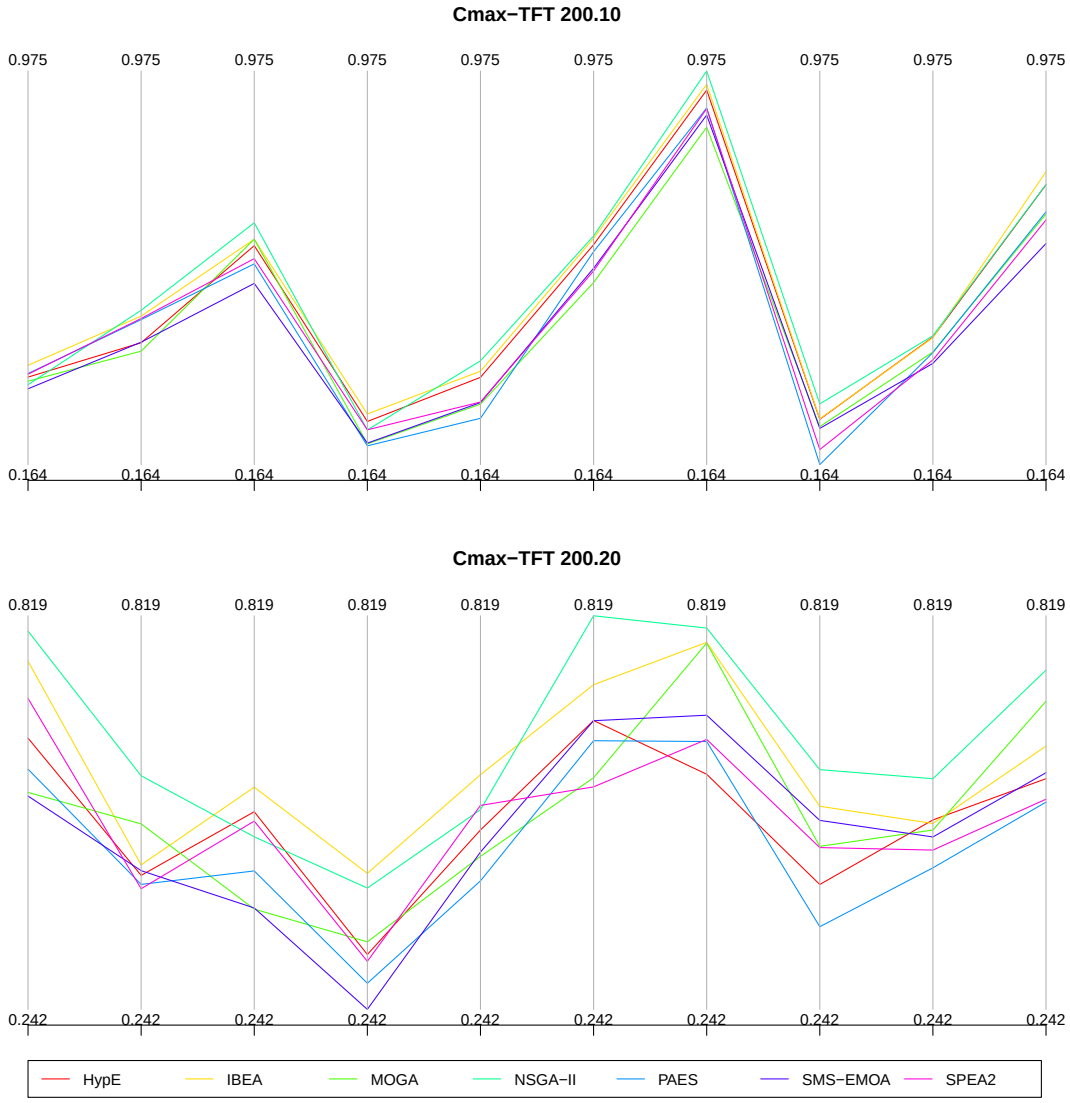

Fig. 4: Average hypervolume over 10 runs on 10 instances with 200 jobs each of Cmax-TFT.

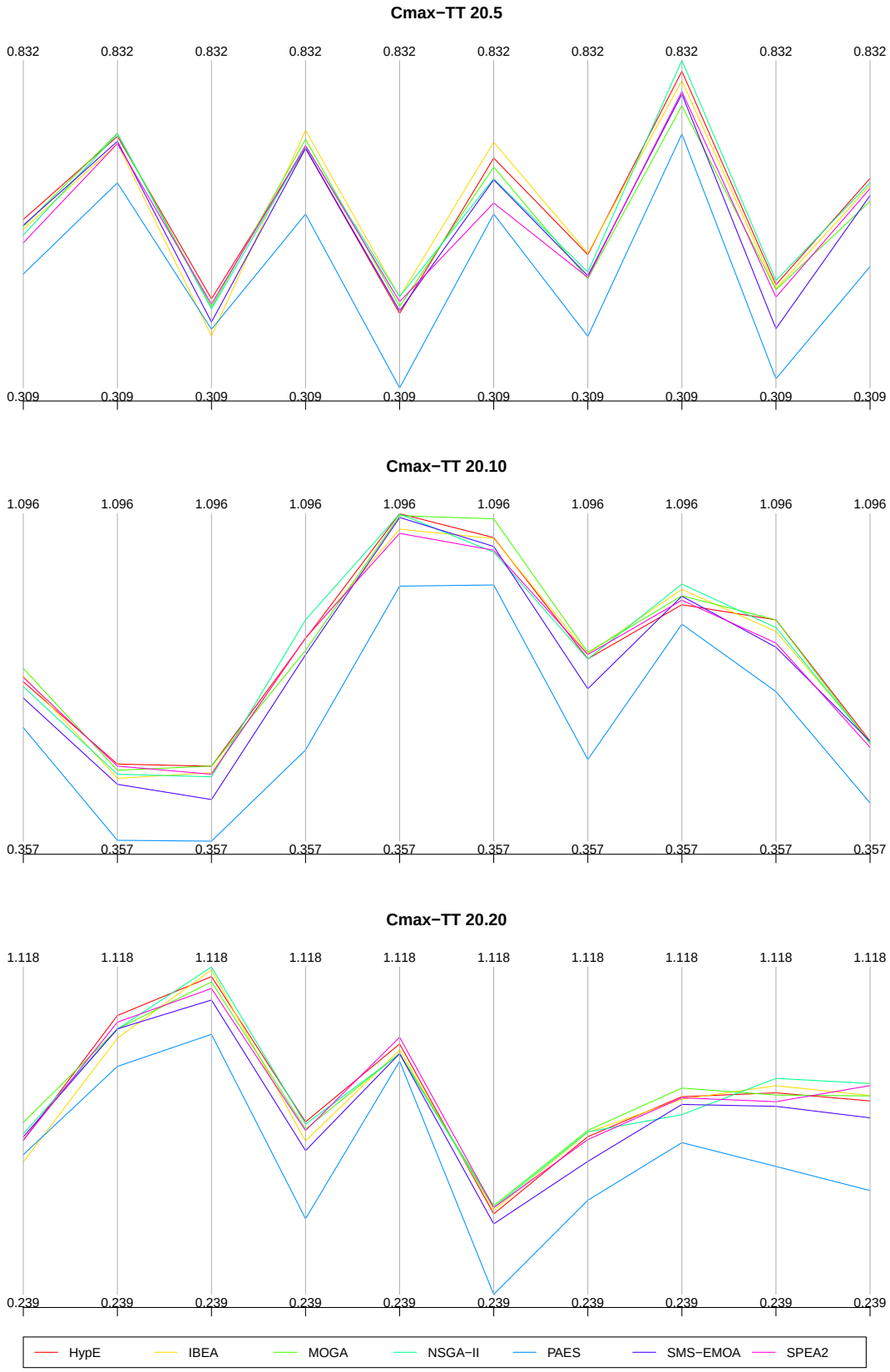

Fig. 5: Average hypervolume over 10 runs on 10 instances with 20 jobs each of Cmax-TT.

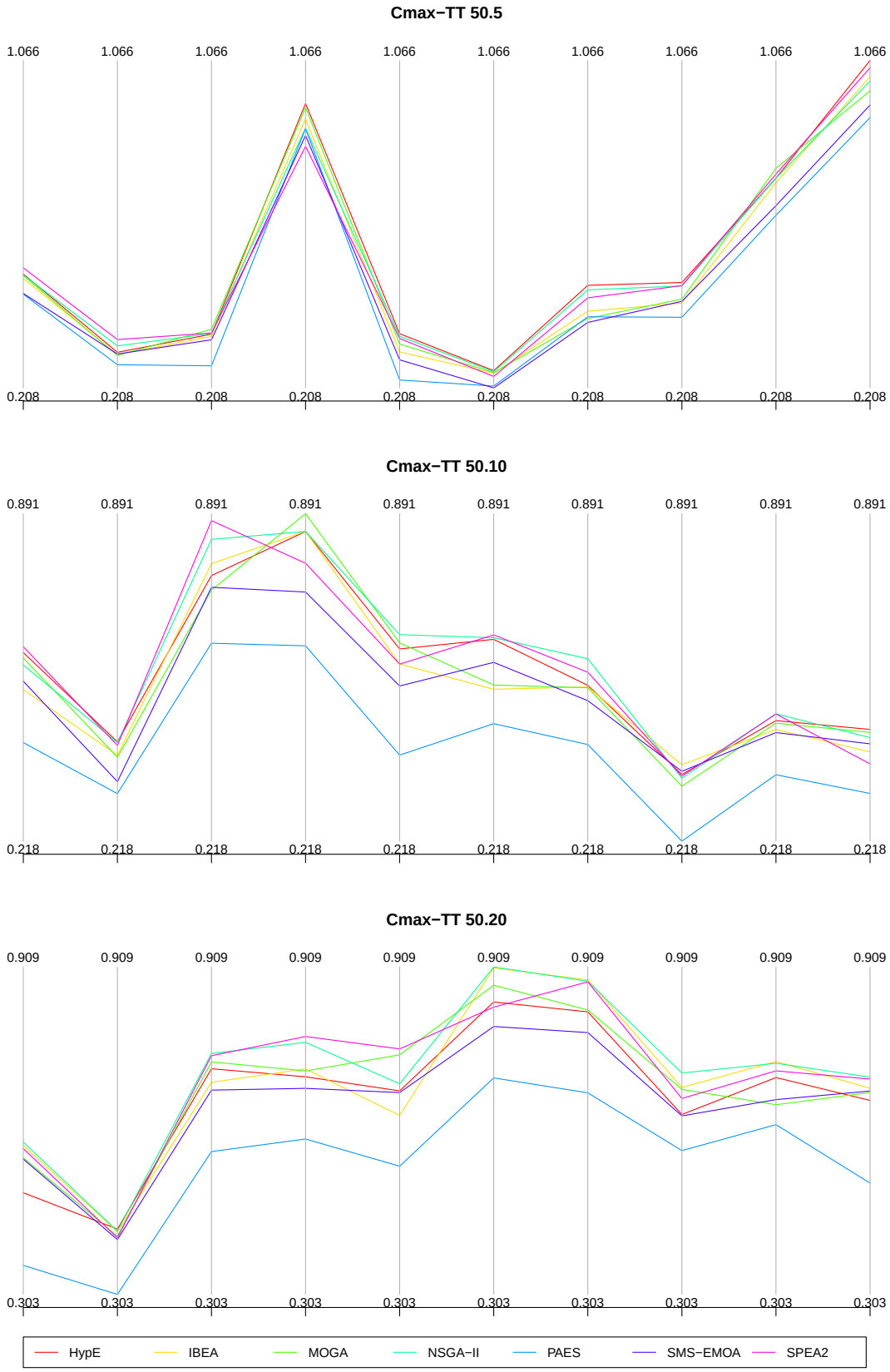

Fig. 6: Average hypervolume over 10 runs on 10 instances with 50 jobs each of Cmax-TT.

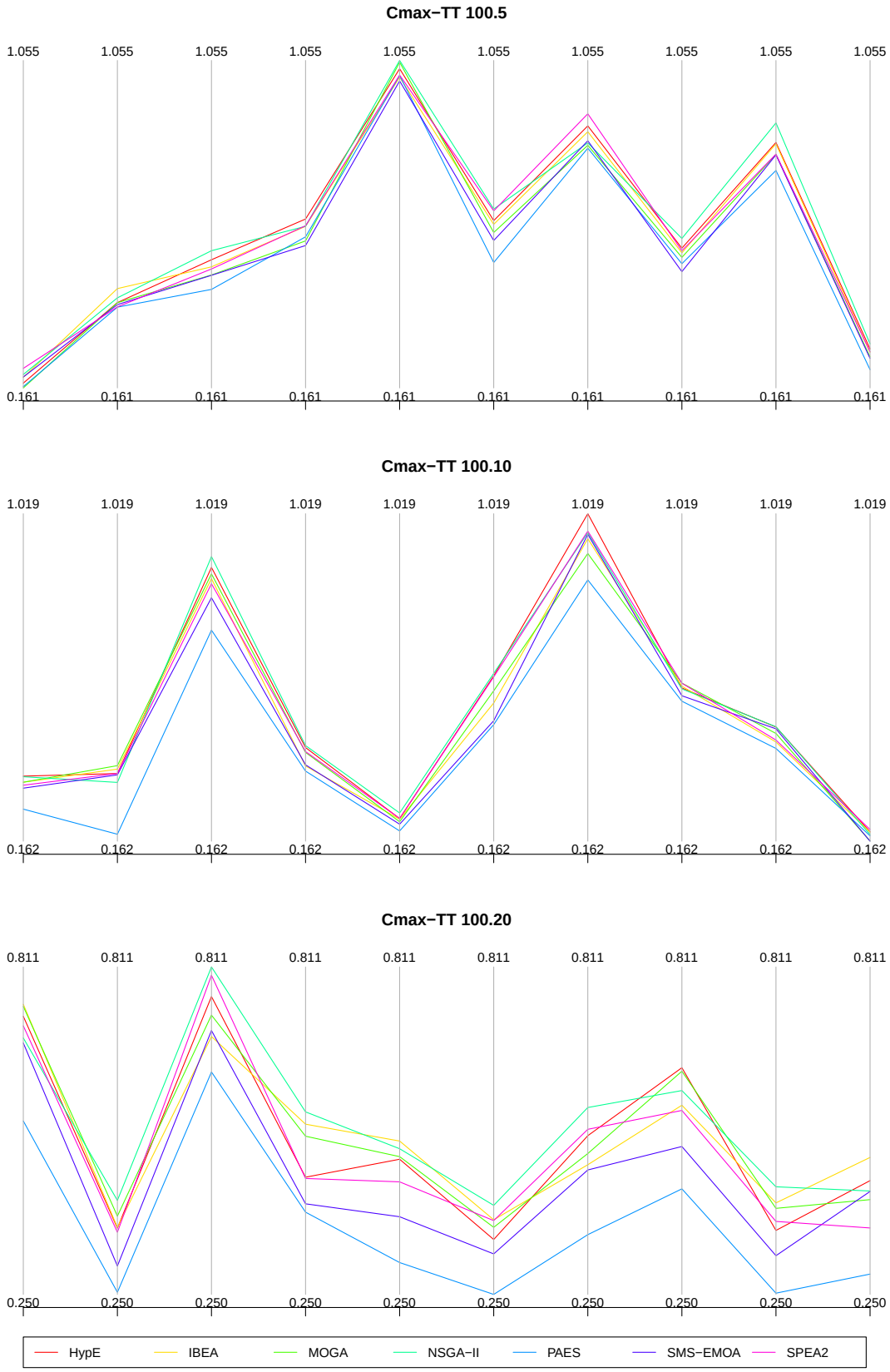

Fig. 7: Average hypervolume over 10 runs on 10 instances with 100 jobs each of Cmax-TT.

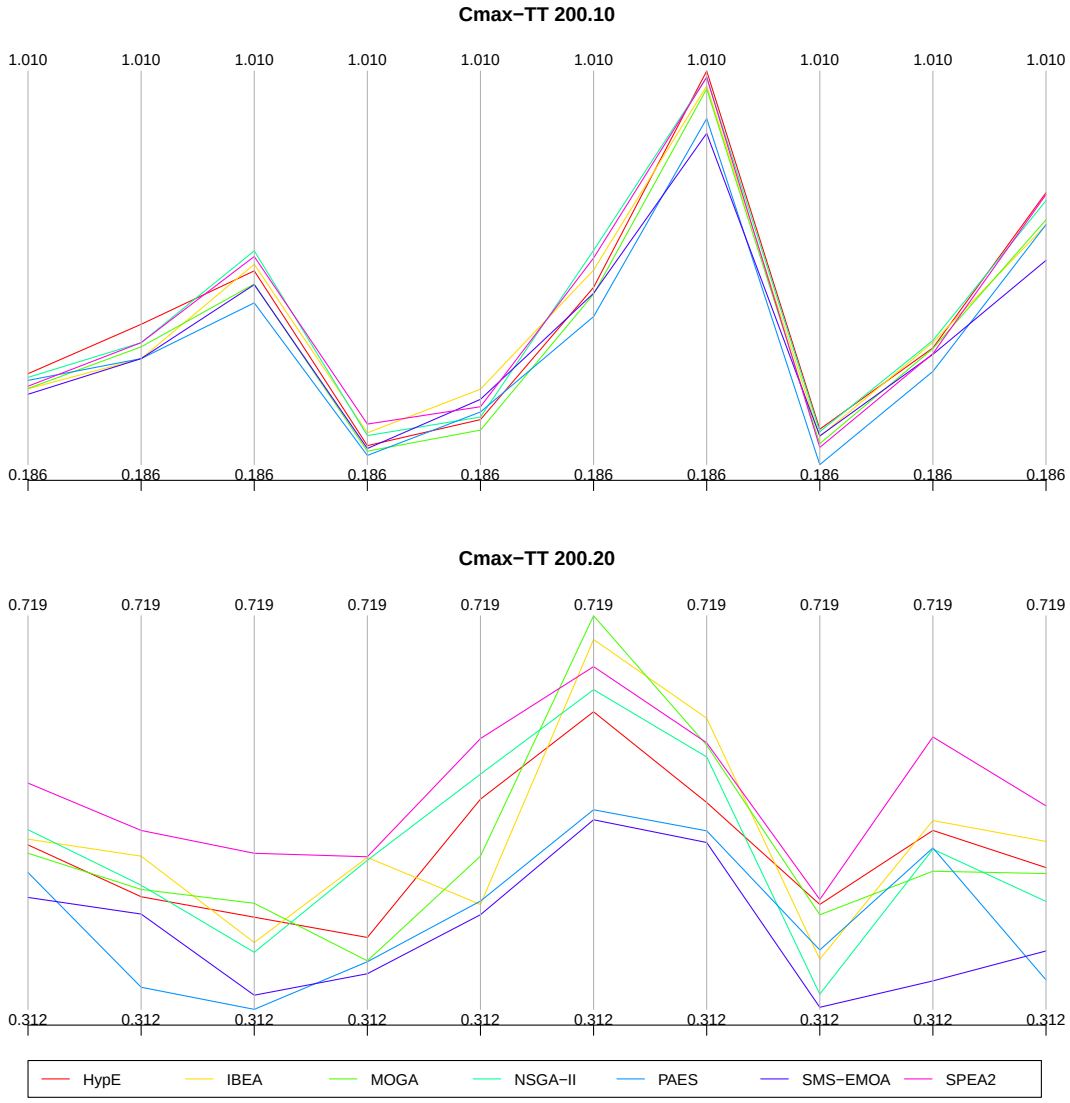

Fig. 8: Average hypervolume over 10 runs on 10 instances with 200 jobs each of Cmax-TT.

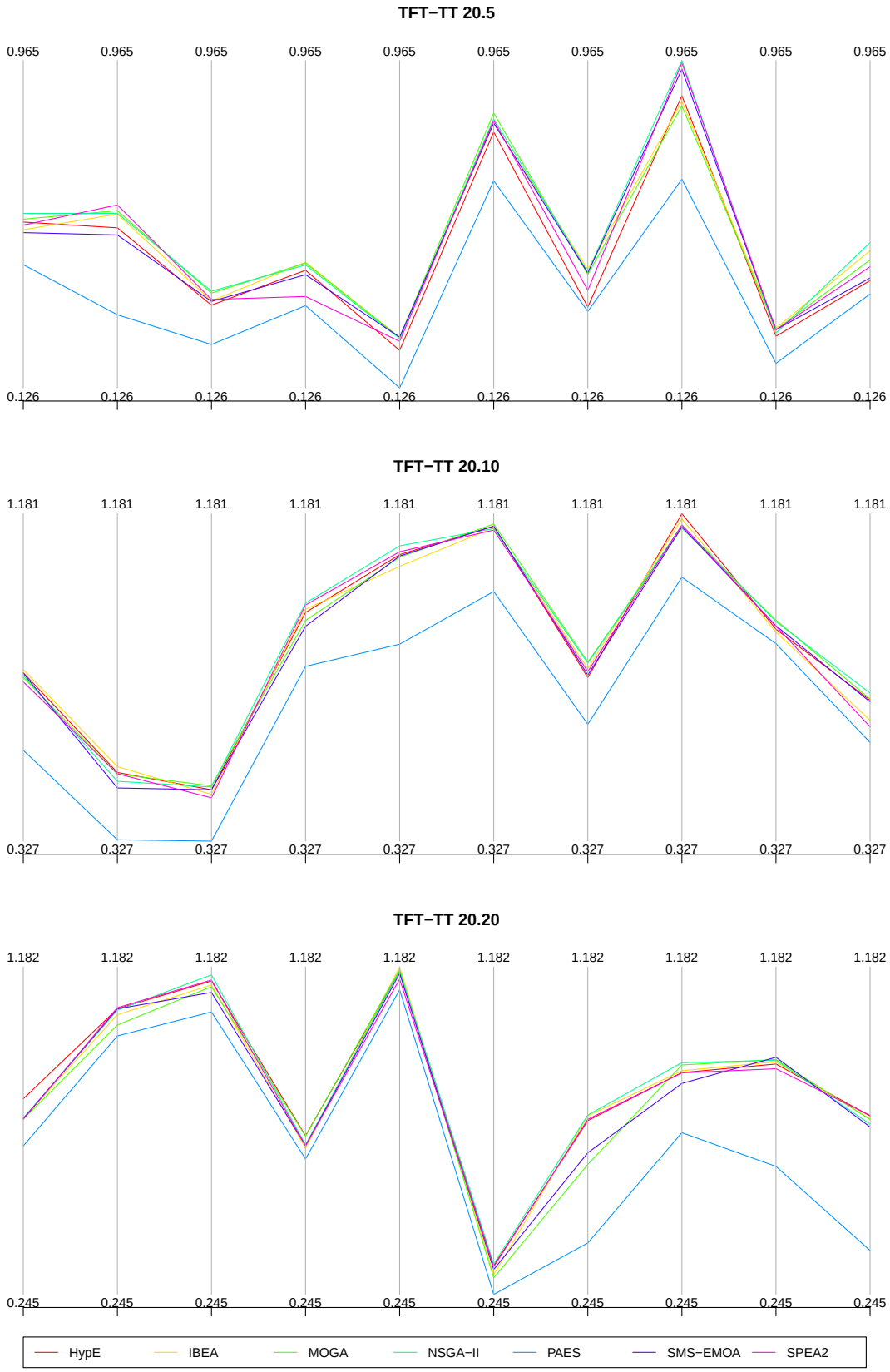

Fig. 9: Average hypervolume over 10 runs on 10 instances with 20 jobs each of TFT-TT.

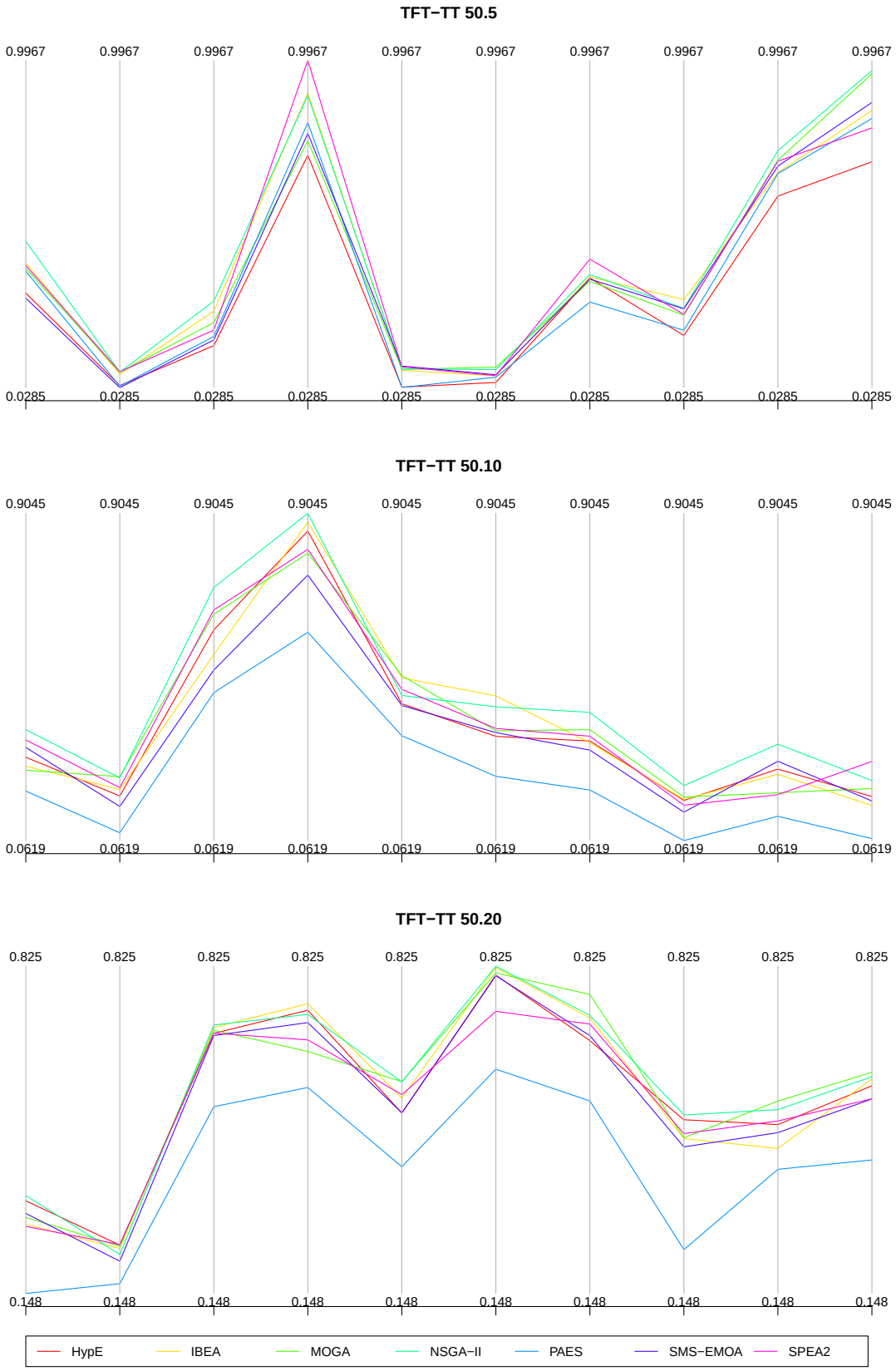

Fig. 10: Average hypervolume over 10 runs on 10 instances with 50 jobs each of TFT-TT.

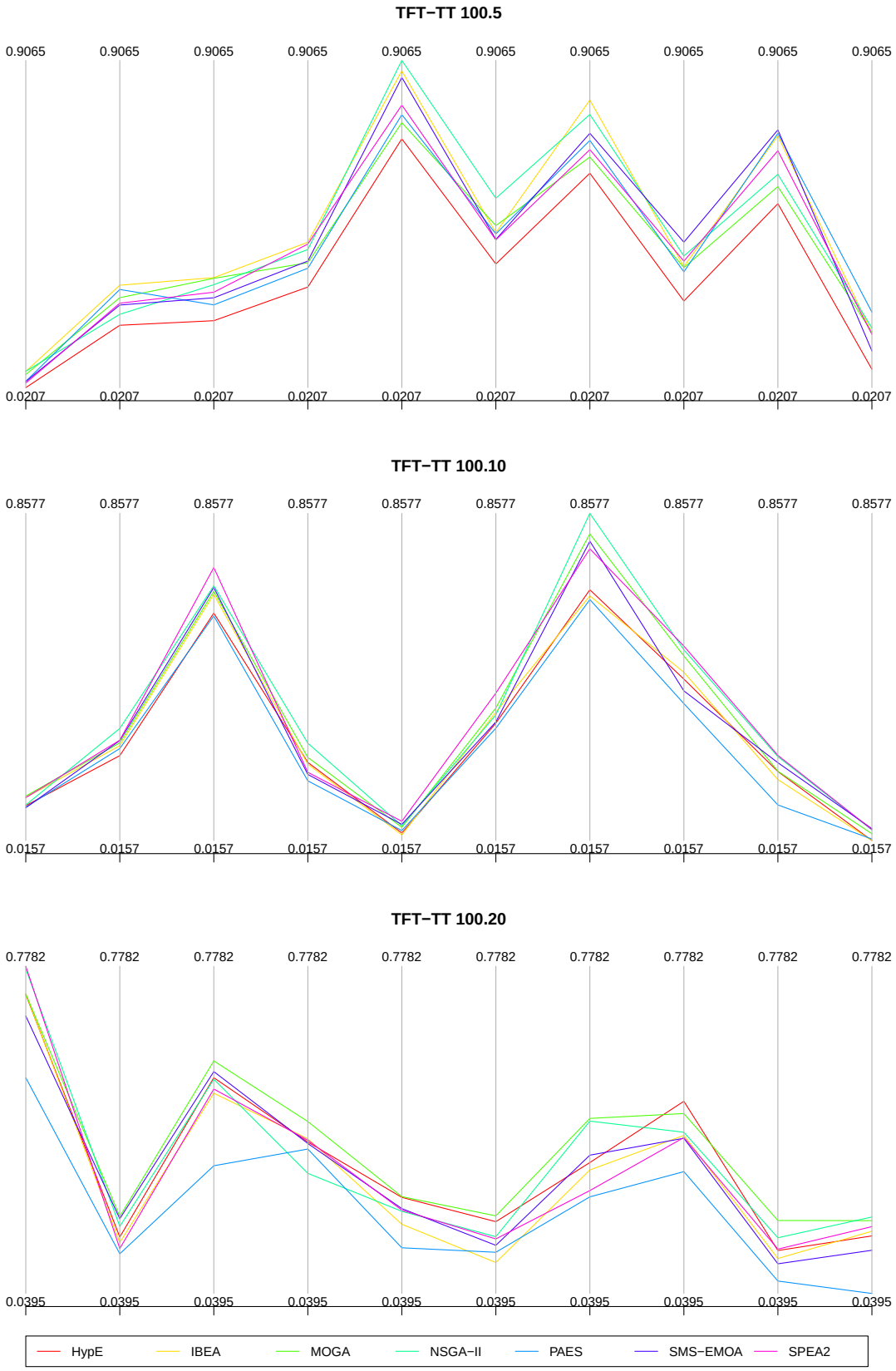

Fig. 11: Average hypervolume over 10 runs on 10 instances with 100 jobs each of TFT-TT.

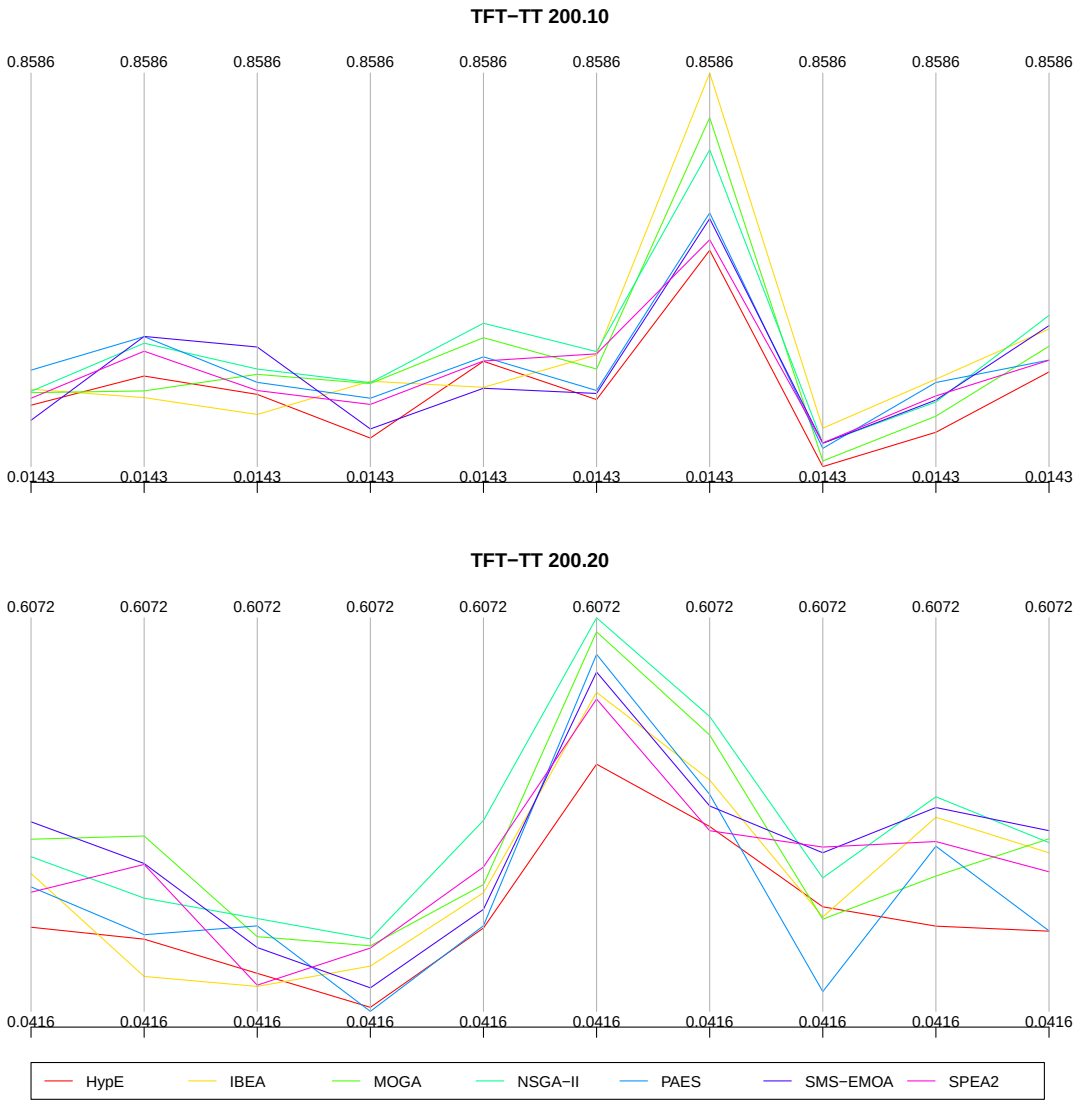

Fig. 12: Average hypervolume over 10 runs on 10 instances with 200 jobs each of TFT-TT.

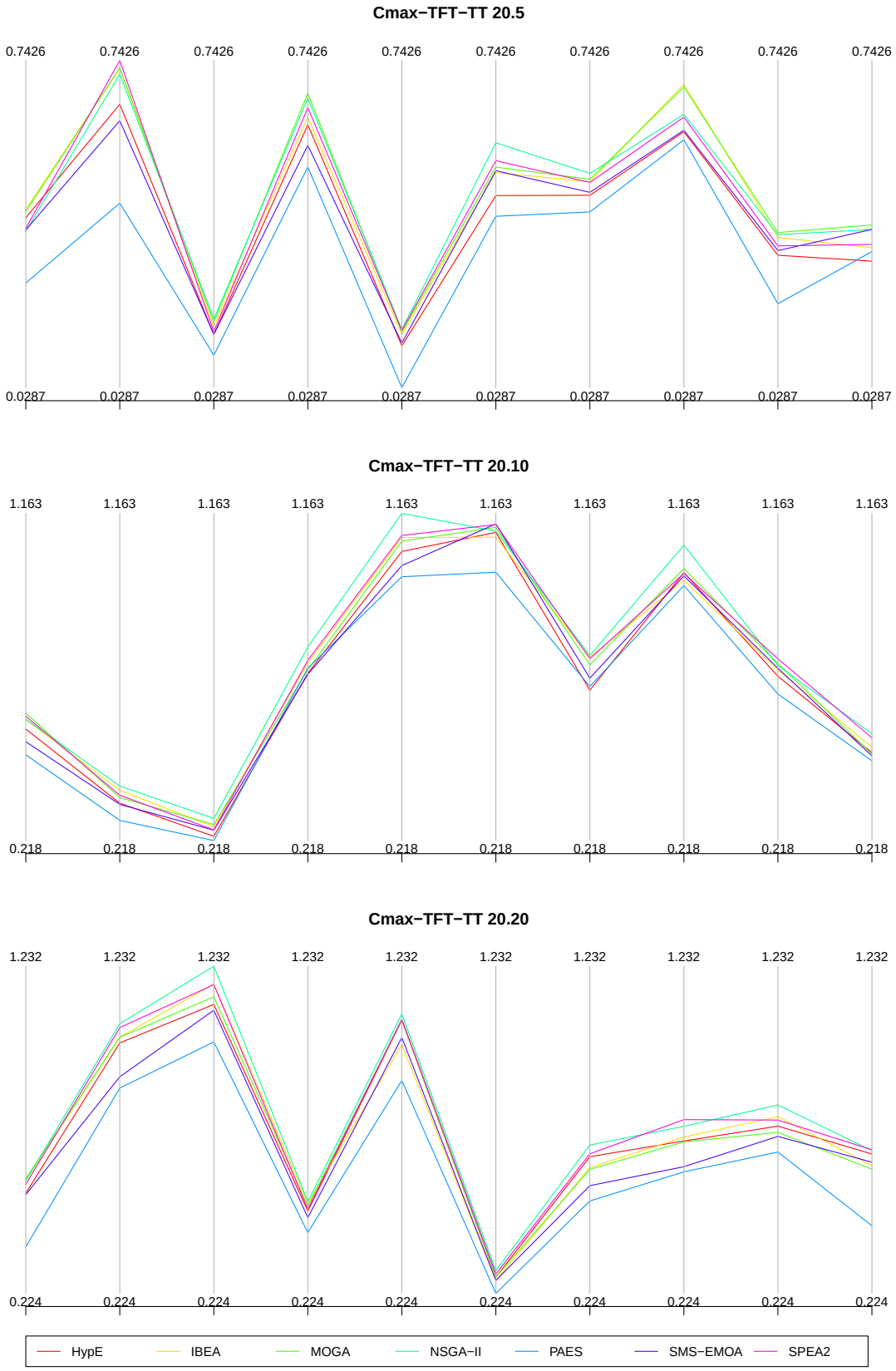

Fig. 13: Average hypervolume over 10 runs on 10 instances with 20 jobs each of Cmax-TFT-TT.

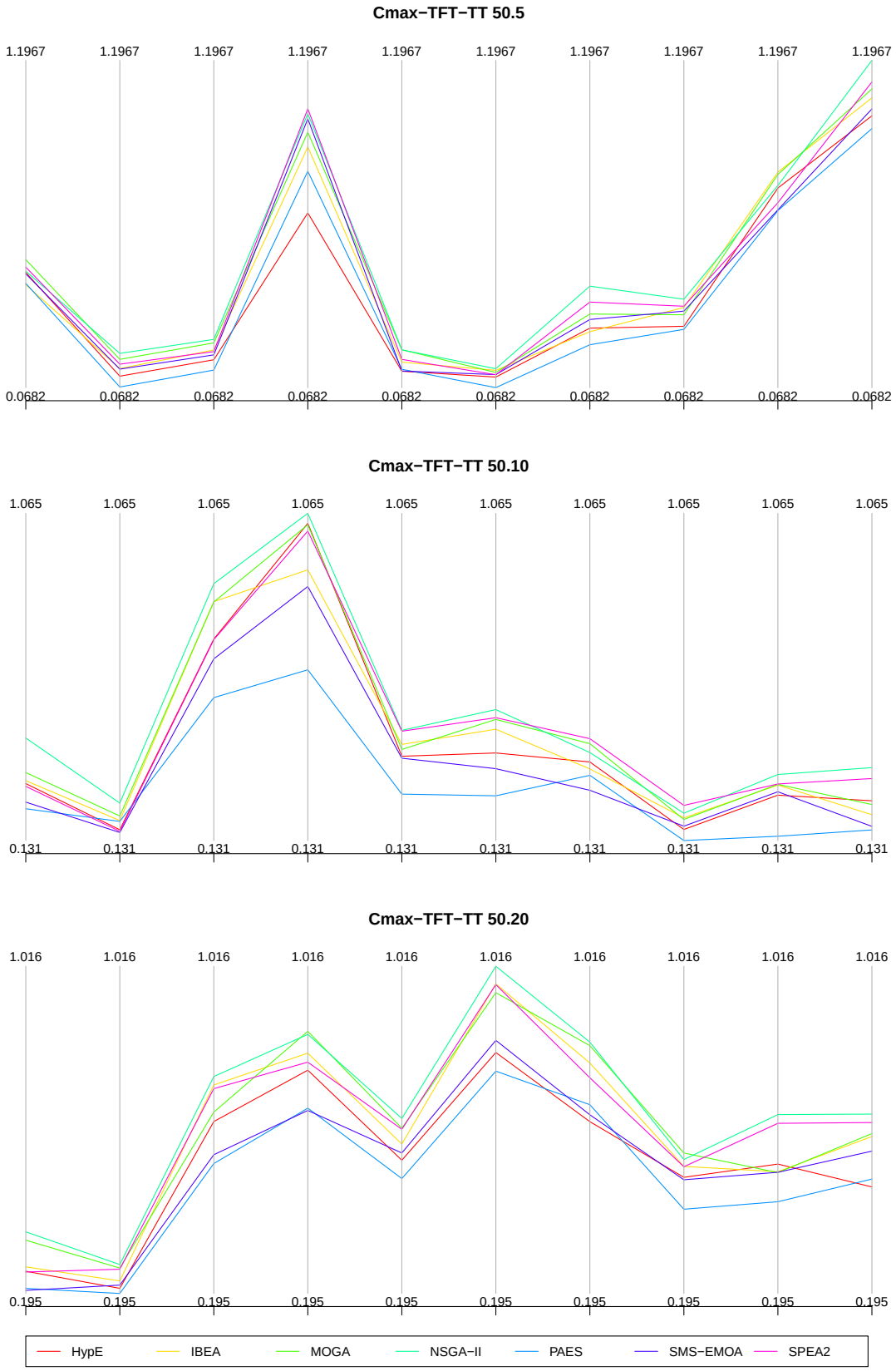

Fig. 14: Average hypervolume over 10 runs on 10 instances with 50 jobs each of Cmax-TFT-TT.

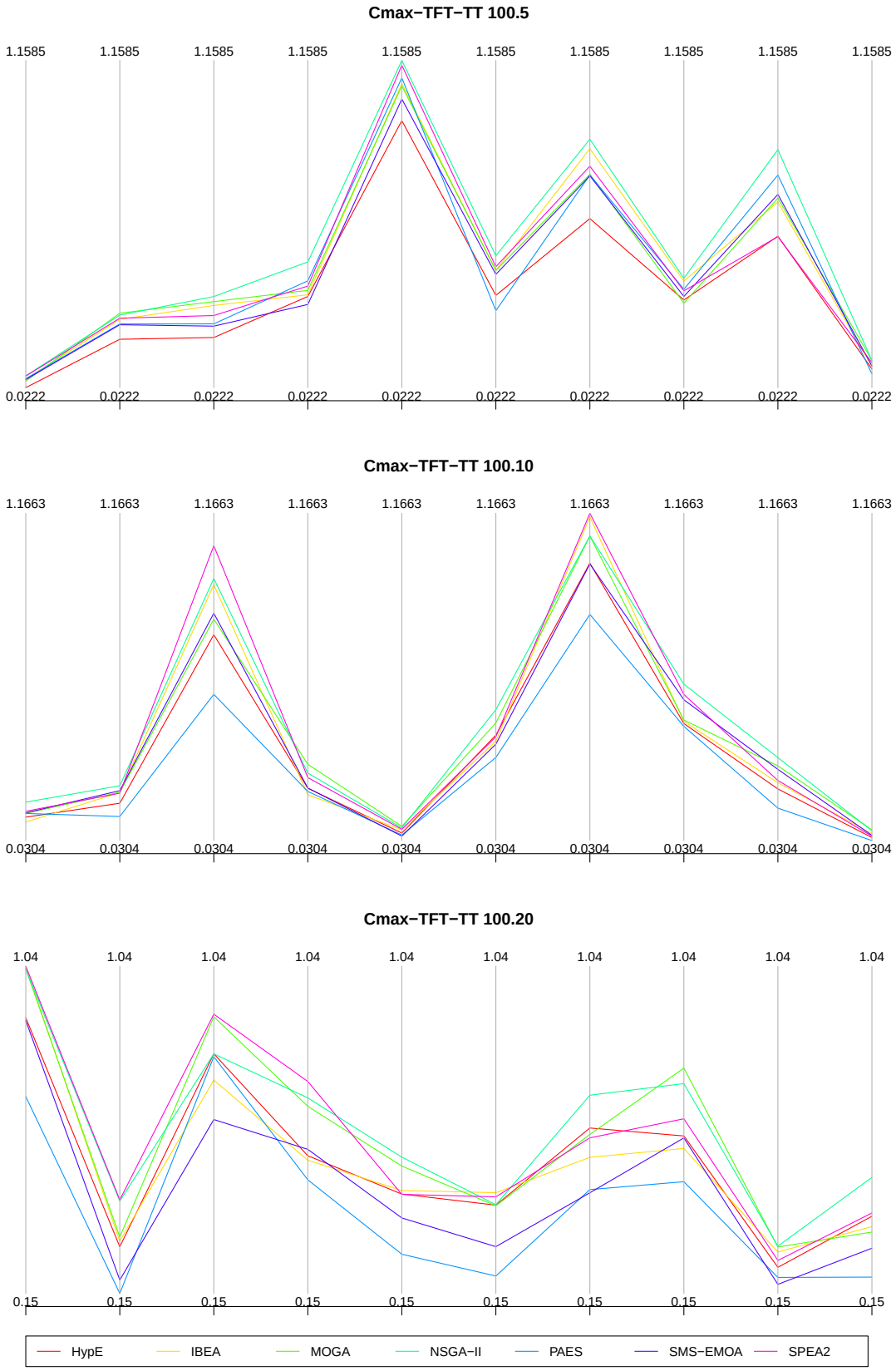

Fig. 15: Average hypervolume over 10 runs on 10 instances with 100 jobs each of Cmax-TFT-TT.

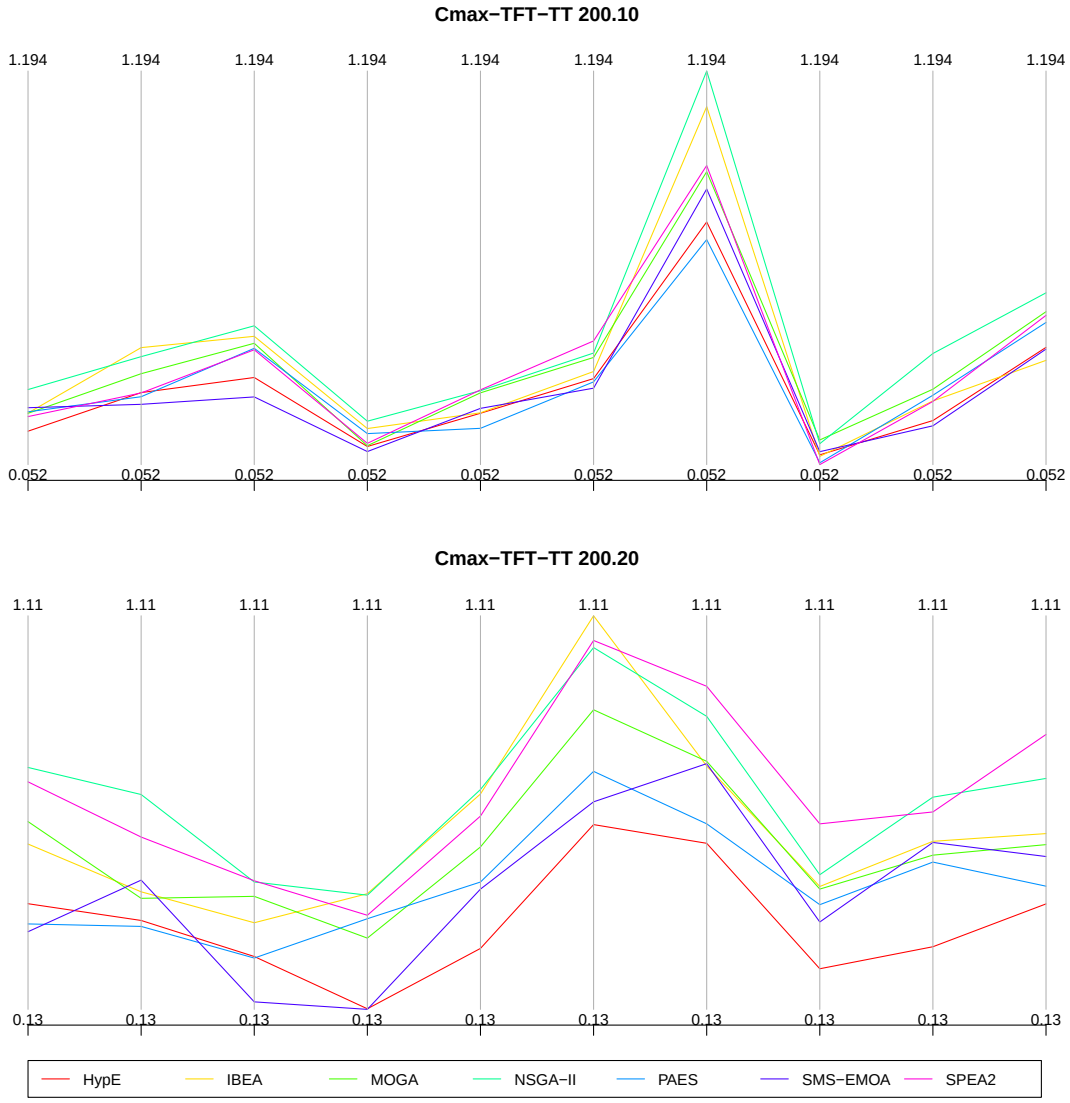

Fig. 16: Average hypervolume over 10 runs on 10 instances with 200 jobs each of Cmax-TFT-TT.