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Interactive comment on "Algorithms for Optimization of Branching Gravity-Driven Water Networks" *by* Ian Dardani and Gerard F. Jones

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This paper looks at the classic problem of pipe diameter selection for branched gravity fed water distribution networks. Specifically it only allows for a single pipe diameter for each link in the network. It looks at three alternative approaches to the problems and compares them over 5 sample networks. A primary concern with the work is that the authors mention in the abstract "three cost-minimization algorithms are developed". But these algorithms are well known techniques as the authors themselves refer to the related past work. It is not made very explicit, what is the new contribution provided by the authors.

If indeed the primary purpose of the paper is to contrast existing techniques on different networks, this purpose should be made more explicit and clear. Further, why was the linear programming approach not considered? It is significantly faster for the problem in question than all the three approaches discussed and provides optimal results.

In a paper where the primary purpose is to test different approaches over different networks, it is a big shortcoming that the range of networks is so small, with the largest network only consisting of 23 links. I recommend including larger networks for the testing.

The problem statement being look at is a single pipe diameter for each link in the network. This is known to be NP hard even when restricted to branched networks [1]. But the more practical problem is one where multiple diameters are allowed (specifically upto two diameters in the optimal case [2]). Also the more general problem is "easier" since it can be solved by an ILP and thus is solved in polynomial time. Given that the allowing multiple diameters is more general, practical, easier and provides lower costs, why was it not considered except for a brief mention in the paper.

Some further specific points about the paper:

1. For the calculus based approach, the authors mention that "Mapping between continuous diameters and the discrete nominal sizes, required to complete the design, will not be addressed in the present work." But this is a non-trivial aspect of the problem and simply taking the nearest larger diameter can significantly impact the cost of the design as the authors themselves note in the results.

2. While the times for the backtracking and genetic algorithms has been reported in the results, there are no exact numbers provided for the CB algorithm. Only a qualitative comment is made as regard to its better scaling. As such why was a larger network not included in the testing process to make the comparison more explicit? Also the tabulation of costs for the different approaches across the sample networks should include the time taken, which will provided a better picture of the trade-off involved in choosing non optimal approaches.

References:

[1] : Yates, D.F., Templeman, A.B., and Boffey, T.B., 1984, "The Computational Com-

plexity of the Problem of Determining Least Capital Cost Designs for Water Supply Networks", Engineering Optimization, 7(2), 142-155

[2] : Fujiwara, Okitsugu, and Debashis Dey., 1987, "Two adjacent pipe diameters at the optimal solution in the water distribution network models." Water Resources Research 23.8: 1457-1460

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