# SUPPLEMENTAL MATERIALS

ASCE *Journal of Water Resources Planning and Management*

# MAGNets: Model Reduction and Aggregation of Water Networks

Meghna Thomas and Lina Sela

**DOI:** 10.1061/JWRMD5.WRENG-5486

*

This supporting information provides instructions for users to reproduce the results of this paper as well as additional figures complementing the paper. Contents of this file:

- Package usage instructions
- Reproducing results
- Figures S1 - S8

## PACKAGE USAGE INSTRUCTIONS

Users can follow installation instructions available on the MAGNets Github landing page (https://github.com/meghnathomas/MAGNets) to install MAGNets on their machine. After installation, a user can run example codes available in the Github `examples` folder (in conjunction with benchmark networks present in `examples/networks`) to explore MAGNets' capabilities.

1. Example 1 demonstrates how MAGNets can be used to reduce a water distribution network model around a given operating point, with the user providing a list of nodes they would like to retain in the model.

2. Example 2 demonstrates how MAGNets can be used to reduce a water distribution network model around a given operating point, with the user providing a list of nodes they would like to retain in the model. Additionally, this example shows how the user can plot the percentage deviation of the pressure heads at each node in the reduced model compared to the original model to test the accuracy of MAGNets. This characterization of error can inform the user of the degree to which they should reduce the model as well as which operating point they should select.
3. Example 3 demonstrates how to find the "best" operating point around which to reduce a model. Here, we define the "best" operating point as the one that results in the lowest maximum percentage deviation of pressure heads in the reduced model compared to the original model.
4. Example 4 demonstrates the mean and median percentage error, number of edges in the reduced model, and reduction time if 25%, 50%, 75%, and 100% of a randomly ordered list of nodes are removed from the model.
5. Example 5 demonstrates the mean and median percentage error, number of edges in the reduced model, and reduction time if 25%, 50%, 75%, and 100% of a statically ordered list of nodes are removed from the model. Before any nodes are removed from the model, all nodes are arranged in ascending order of their nodal degree and this list ordering remains unchanged after each node is removed (unlike in MAGNets, where the list is dynamically updated after each node is removed from the model).

## REPRODUCING RESULTS

Users can also reproduce the results reported in the paper by running codes located in https://github.com/meghnathomas/MAGNets/tree/master/publications.

1. Table 1 – the user should run code `reproduce_table_1.py`. Note that running times will depend on the machine used to execute the codes.
2. Figure 3 – the user should run code `reproduce_figure_3.py`

3. Figure 4 – the user should run code `reproduce_figure_4.py`
4. Figure 5 – the user should run example 2 (for dynamic order), example 4 (for random order), and example 5 (for static order) for networks NET3, KY2, and BWSN2 located in https://github.com/meghnathomas/MAGNets/tree/master/examples/networks.

## List of Figures

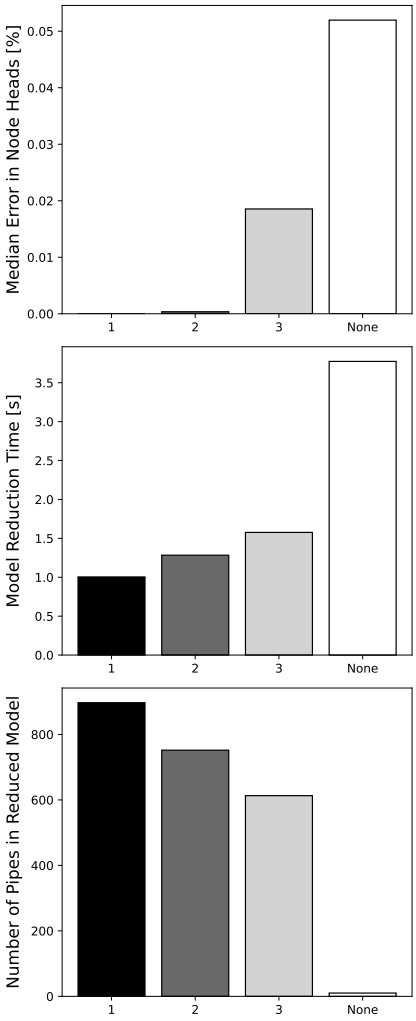


**Fig. S1.** KY2: Median error, reduction time, and number of pipes in the reduced model based on the maximum degree of removed nodes: 1, 2, 3, and no restriction.

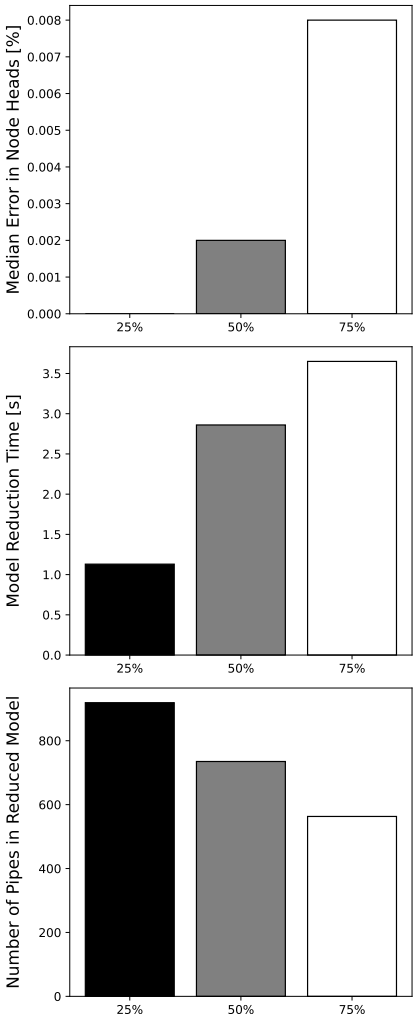


**Fig. S2.** KY2: Median error, reduction time, and number of pipes in the reduced model based on the percentage of removed nodes: 25%, 50%, and 75%.

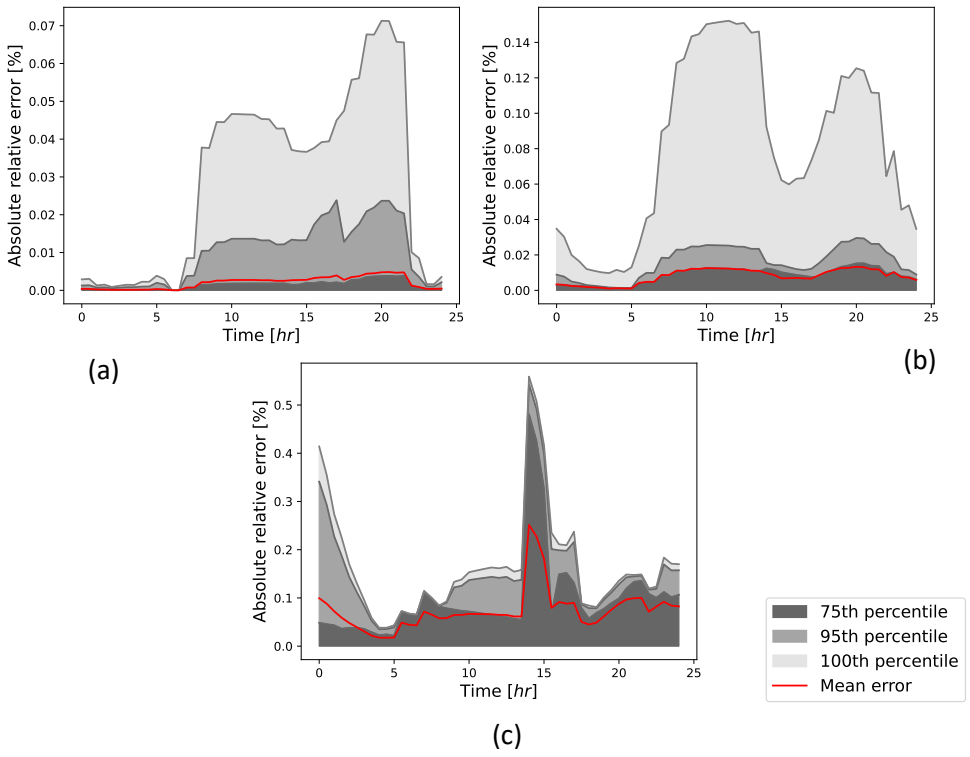


**Fig. S3.** KY2: Absolute relative error in models reduced with: (a) maximum nodal degree = 2 using MAGNets; (b) maximum nodal degree = 2 using WNTR; and (c) without node degree restriction using MAGNets.

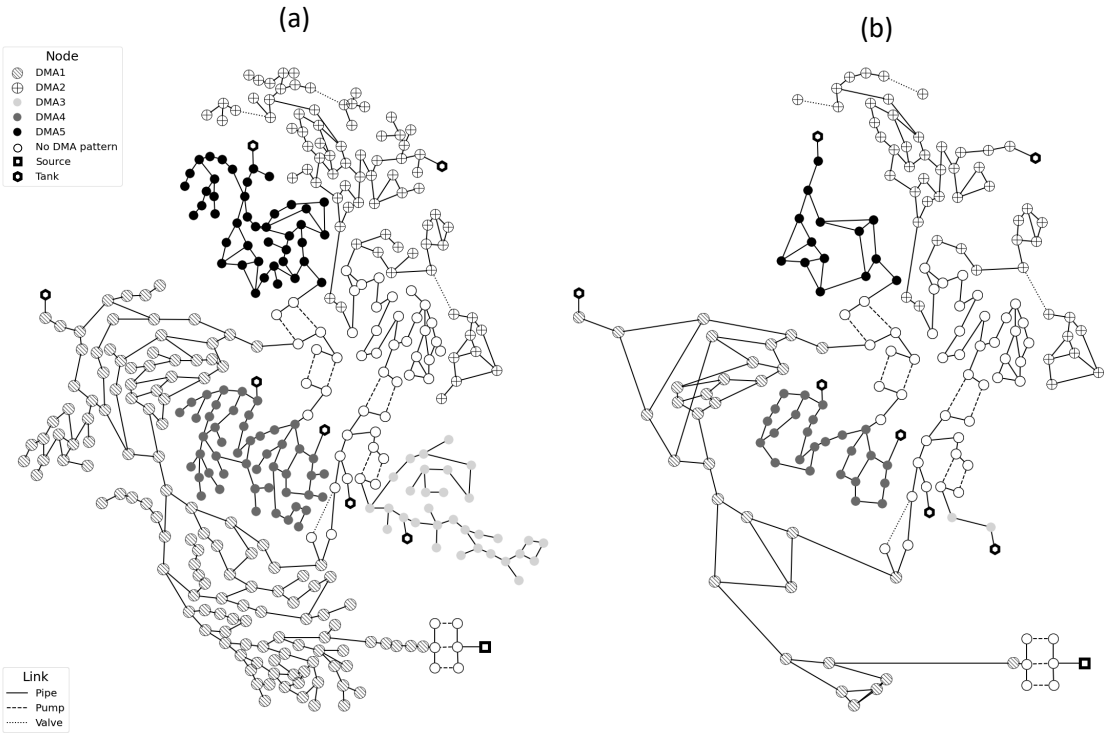


**Fig. S4.** C-Town layout: (a) full model and (right) reduced model with all branches removed and nodes with nodal degree 2 removed from DMA1, DMA3, and DMA5.

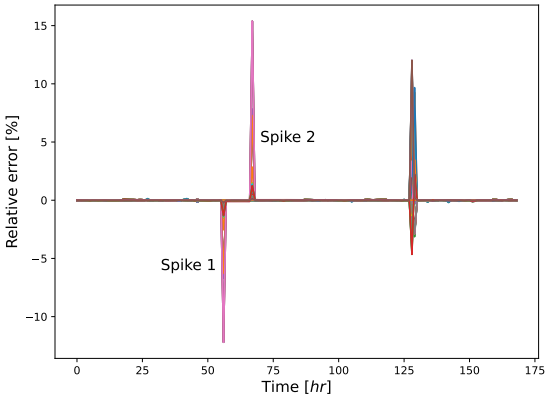


**Fig. S5.** C-Town: Relative error between node heads in original model and reduced model with all branches removed and nodes with nodal degree 2 removed from DMA1, DMA3, and DMA5.

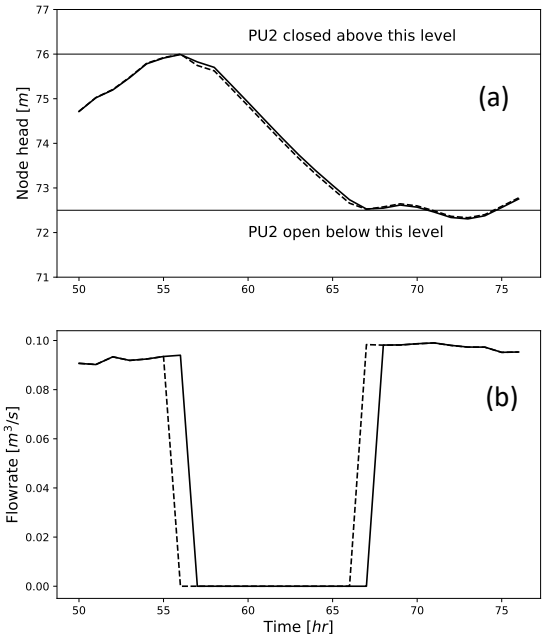


**Fig. S6.** C-Town simulation results for the original (solid line) and reduced (dashed line) models: (a) water level in tank T1 and (b) flow rate in pump PU2.

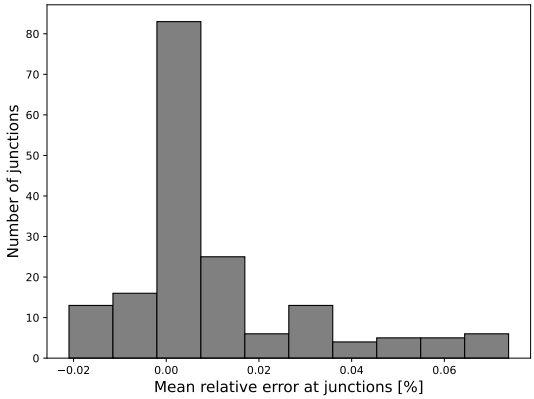


**Fig. S7.** C-Town: Distribution of the mean relative nodal head errors between the original model and reduced model with all branches removed and nodes with nodal degree 2 removed from DMA1, DMA3, and DMA5.

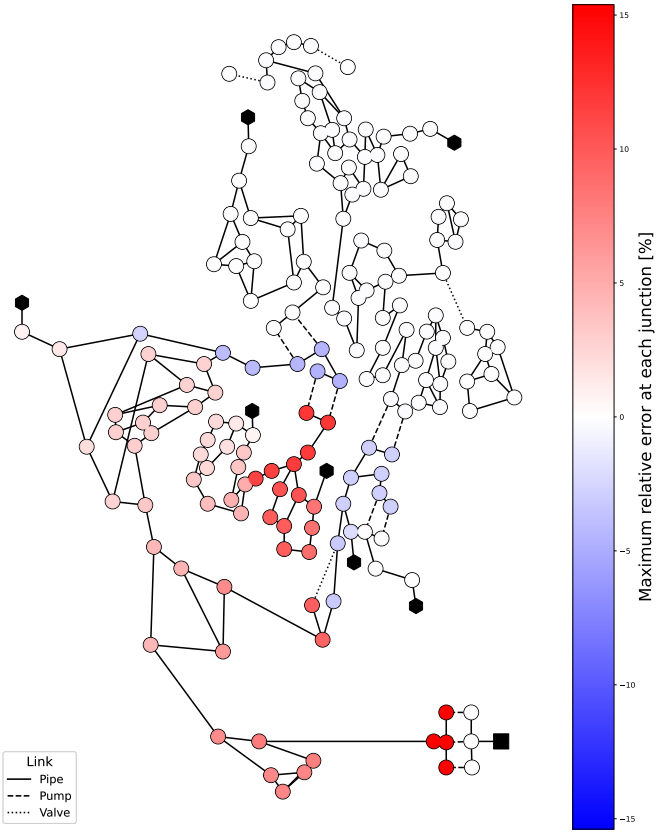


**Fig. S8.** C-Town: Spatial distribution of the maximum relative nodal head error for each node remaining in the reduced model with all branches removed and nodes with nodal degree 2 removed from DMA1, DMA3, and DMA5.