Errata sheet for the article "A Matheuristic for the Liner Shipping Network Design Problem" by Brouer, Desaulniers and Pisinger

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1 Solutions with a weekly frequency

The solutions reported in the article *"A Matheuristic for the Liner Shipping Network Design Problem", Transportation Research Part E, 72, p. 42-59 (2014)* by B.D. Brouer, G. Desaulniers and D. Pisinger enforces a minimum speed along with a 24 hour port stay at each port. It has come to our attention that some services created by the construction heuristic requires a longer port stay than 24 hours in order to maintain the weekly frequency requirement. It means that the vessel is allowed more idle time at port and unfortunately, the fuel cost during this idling time has not been accounted for. The extra cost is minimal and does not change the overall objective value significantly as can be seen from the document `CorrectionSheetResultsBrouerDesaulniersPisinger.xlsx` published along with this errata sheet. We have also published the best networks of our algorithm along with LINER-LIB 2012 in order for the community to be able to compare their own results to our solutions. In the article we obtain 10 new best found solutions for the LSNDP. Five of these do not have any services with additional idling time, but the remaining five do have a number of services with extra idling time. We have fixed the error in the code (with no other improvements) and rerun tests for these five instances. For one instance we cannot claim to have the best solution, for the remaining four our solutions are an improvement to those of *"A base integer programming model and benchmark suite for the Liner Shipping Network Design Problem", Transportation Science 48(2), (2014)* by Brouer, Alvarez, Plum, Pisinger and Sigurd. For two instances we even find better solutions than those reported in *"A Matheuristic for the Liner Shipping Network Design*

Problem", Transportation Research Part E, 72, p. 42-59 (2014) by B.D. Brouer, G. Desaulniers and D. Pisinger. The corrected networks are published along with the original best networks.

We sincerely apologize for this error in the code, but hope that the community can move forward with these new published networks if new best solutions are found for the version of the problem with extra idling time as well as the version where a port stay off exactly 24 hours is required.

2 Objective function value

An additional error has been detected as the objective function values are based on a weekly network cost/revenue, which in the comparison is multiplied to 180 days to compare with *"A base integer programming model and benchmark suite for the Liner Shipping Network Design Problem", Transportation Science 48(2), (2014)* by Brouer, Alvarez, Plum, Pisinger and Sigurd. To this effect an error of integer division means that only 25 weeks corresponding to 175 days is accounted for giving a higher half year objective value for all instances.

3 World Small 2

In the World Small instance demands exceeding 1000 TEU has a thousand separator. In the workld small instance this has been treated as a comma, and hence the total TEU of demand is significantly smaller int he WorldSmall instance reported in our article compared to *"A base integer programming model and benchmark suite for the Liner Shipping Network Design Problem", Transportation Science 48(2), (2014)* by Brouer, Alvarez, Plum, Pisinger and Sigurd. We have created the instance WorldSmall 2 with the same demand as in *"A base integer programming model and benchmark suite for the Liner Shipping Network Design Problem", Transportation Science 48(2), (2014)* by Brouer, Alvarez, Plum, Pisinger and Sigurd and publish the new results for this instance here.

4 Corrected results

LINER-LIB is being used by peer researchers and their work has pointed to implementation errors in the matheuristic, and in this survey we bring corrected and updated results according to their findings. There are currently three known sources of errors:

- Parsing demands above 1000 TEU in the *WorldSmall* instance has been interpreted differently in Brouer et al. [2014] than in **?** as a thousand seperator has been interpreted as a comma in **?**.

- When scaling the weekly objective value to the planning horizon of 180 days an error results in only scaling by 175 days (25 weeks) instead of 180 days as in Brouer et al. [2014] due to integer division of 180 instead of division in **R**.
- In the original results the construction heuristic allows services with a longer port stay than 24 hours in order to maintain the weekly frequency requirement. It means that the vessel is allowed more idle time at port and unfortunately, the fuel cost during this idling time has not been accounted for.

In the article **?** new best results where found for ten instances. We have fixed the above mentioned issues in the source code. New tests have been performed with the errors corrected for those instances of the matheuristic having the current best known results *and* one or more services in the best found network did include extra idling time. For the remaining instances with one or more services having extra idle time the cost of extra idling in ports over the planning horizon was added to the objective value. Likewise, we have made runs with corrected input for *WorldSmall* containing the demand quantity used in *WorldSmall* of Brouer et al. [2014]. Table 1 states the corrected results for all instances and the *WorldSmall Brouer et al. [2014]*, where the comma is correctly interpreted as a thousand seperator. The results show that the performance of the algorithm is not influenced by the errors and results actually improve for *WAF (low)* , as well as showing improved results for *WorldSmall Brouer et al. [2014]*. We are gratefull for our peer researchers drawing our attention to issues and errors, and apologize for any inconvenience caused. All best known networks along with an erratasheet can be found on the LINERLIB git hub repository, which is available to the public at *https://github.com/BBRouer/Linerlib*.

References

References

B.D. Brouer, J.F. Alvarez, C.E.M Plum, D. Pisinger, and M.M. Sigurd. A base integer programming model and benchmark suite for liner shipping network design. *Transportation Science*, 48 (2):281–312, 2014.

Instance			Brouer et al. [2014]	Matheuristic			
Instance			(Bi)weekly Z	Weekly Z	Depl%	Trans%	Time
Baltic	Low	Best	$-6.04 \cdot 10^6$	$3.59 \cdot 10^6$	100.0	84.0	27
		Average		$5.35 \cdot 10^6$	100.0	83.3	34
	Base	Best	$-8.37 \cdot 10^6$	$-6.29 \cdot 10^6$	100.0	92.1	105
		Average		$-2.59 \cdot 10^6$	100.0	89.3	69
	High	Best	$-1.57 \cdot 10^7$	$-1.11 \cdot 10^7$	100.0	94.7	33
		Average		$-7.40 \cdot 10^6$	100.0	92.5	45
WAF	Low	Best	$-1.18 \cdot 10^8$	$-1.14 \cdot 10^8$	97.0	91.7	95
		Average		$-1.04 \cdot 10^8$	98.5	88.8	105
	Base	Best	$-1.43 \cdot 10^8$	$\mathbf{-1.44 \cdot 10^8}$	90.5	97.0	93
		Average		$-1.32 \cdot 10^8$	93.3	95.5	105
	High	Best	$-1.60 \cdot 10^8$	$\mathbf{-1.61 \cdot 10^8}$	80.4	97.2	98
		Average		$-1.54 \cdot 10^8$	85.1	97.3	126
Mediterranean	Low	Best	$2.95 \cdot 10^7$	$5.52 \cdot 10^7$	100.0	80.2	219
		Average		$5.73 \cdot 10^7$	100.0	81.5	216
	Base	Best	$1.22 \cdot 10^7$	$3.31 \cdot 10^7$	100.0	93.8	319
		Average		$3.68 \cdot 10^7$	99	92.6	304
	High	Best	$6.60 \cdot 10^6$	$2.42 \cdot 10^7$	88.0	98.6	377
		Average		$2.71 \cdot 10^7$	92	97.4	381
Pacific	Low	Best	$8.46 \cdot 10^7$	$\mathbf{6.67 \cdot 10^7}$	100.0	90.3	3602
		Average		$1.21 \cdot 10^8$	98.6	88.1	3604
	Base	Best	$-5.41 \cdot 10^7$	$\mathbf{-7.88 \cdot 10^7}$	100.0	95.7	3603
		Average		$-3.21 \cdot 10^7$	97.6	96.3	3604
	High	Best	$-1.02 \cdot 10^8$	$\mathbf{-1.61 \cdot 10^8}$	90.8	100.0	3605
		Average		$-1.31 \cdot 10^8$	94.0	99.2	3606
WorldSmall	Low	Best		$-9.39 \cdot 10^8$	100.0	87.7	10828
		Average		$-6.76 \cdot 10^8$	99.3	86.1	10834
	Base	Best		$-1.44 \cdot 10^9$	98.5	94.2	10885
		Average		$-1.26 \cdot 10^9$	97.6	93.3	10841
	High	Best		$-1.65 \cdot 10^9$	90.2	95.0	10825
		Average		$-1.09 \cdot 10^9$	90.9	93.7	10828
WorldSmall Brouer et al. [2014]	Low	Best	$-5.52 \cdot 10^8$	$\mathbf{-9.72 \cdot 10^8}$	100.00	88.75	10818
		Average		$-7.48 \cdot 10^8$	99.80	86.61	10817
	Base	Best	$-1.15 \cdot 10^9$	$\mathbf{-1.52 \cdot 10^9}$	100	93.28	10800
		Average		$-1.37 \cdot 10^9$	98.85	93.72	10800
	High	Best	$-1.29 \cdot 10^9$	$\mathbf{-1.71 \cdot 10^9}$	94.63	94.53	10816
		Average		$-1.60 \cdot 10^9$	94.32	94.44	10827
		Best	$-3.61 \cdot 10^8$	$\mathbf{-3.84 \cdot 10^8}$	97.9	85.0	14550