

On the optimum route search along the Arctic sea routes

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We have been developing a route optimization system for the Arctic sea routes using A*-algorithm [Yamaguchi and Nakano, 2016]. This time the system is extended to minimize the fuel consumption as well as the sailing distance and the sailing time. Two large ice-class cargo vessels with realistic particulars and hull forms are assumed. They are a 73,000 DWT Panamax size bulk carrier and a 87,300 DWT container ship. Since they are commercial vessels, icebreaking sailing is not realistic but the sailing with displacing the ice floes away is realistic under moderate or low ice concentration conditions. Thus, the ice-displacement resistance is theoretically estimated by the ice tank verified equations, and then engine output and fuel consumption rate are obtained. In this abstract, only the results of the bulk carrier are shown to save the space. Figure 1 shows the optimized route to minimize the fuel consumption. In this case, the route started on Sep. 1st, 2013 and ended on Sep 8th, using AMSR2 sea ice concentration data. Table 1 compares the optimized routes to minimize the sailing distance, sailing time and fuel consumption. It can be seen that the fuel saving route is not a short-cut route but an ice-detour route, resulting in time-saving route as well. Similar results have been obtained for the container ship. In summary, the results have suggested that the most economic route does not enter the ice area by avoiding the ice, and as a result this route becomes close to the shortest sailing time route.

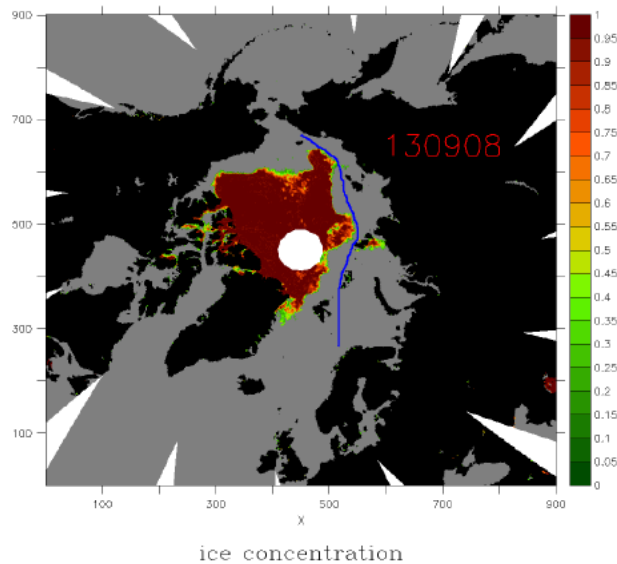


Fig. 1 Optimized route for a 73,000 DWT Panamax size bulk carrier to minimize the fuel consumption

Table 1 Comparison of optimized routes for sailing distance, sailing time and fuel consumption of a 73,000 DWT Panamax size bulk carrier

	Sailing distance [nm]	Sailing time [hours]	Fuel consumption [ton]
Distance minimized	2500	235.9	231.2
Time minimized	2553	182.6	199.0
Fuel minimized	2553	182.6	199.0

References

Yamaguchi, H. and Y. Nakano, Research on navigation support system and optimum route search for the Northern Sea Route, Proc. 23rd IAHR International Symposium on Ice, Ann Arbor, Michigan USA, May 31 - June 3, 2016, ISSN: 2414-6331, 8p.