Fast computation of Arctic Sea Route Search Systems using GPUs

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A container ship stranding accident occurred in the Suez Canal in March 2021. This blocked traffic in the canal, and it took ten days for congestion to ease. This incident pointed out the danger of the concentration of the transportation network, and the Northern Sea Route (NSR) attracted attention as an alternative transportation method to decentralize the transportation network.

In the case of the NSR, it is essential to ensure a safe route to determine the shipping route based on the icebreaking capacity of the vessel and the sea ice conditions. If the ship is operated incorrectly, a collision with the ice could cause a serious accident. At present, such decisions depend on the experience of the crew. However, there are few opportunities to gain onboard expertise in sea ice areas. Therefore, training using actual routes is required, as in the exercises on the map, to complement the experience. In addition to training, safer navigation would be possible if the support system supports secure and efficient navigation. Establishing a ship navigation support system for sea ice areas is an urgent issue for the development of the NSR.

This study has developed an Arctic Sea Route Search System that automatically calculates safe and efficient routes. This system is developed and published as a web application, so that necessary data can be automatically obtained from the network and can calculate the optimal route according to the vessel's capabilities. The system is designed so that anyone can quickly get the optimal route by operating the GUI on the screen. The program uses the Ice Index method to estimate ship speed and the route search method to find the optimal route. By using GPUs to perform some of the calculations, calculations can be performed 3.75 times faster on average and up to 7.04 times faster than with conventional systems. The validity of the system was verified by comparison with AIS data. This clarified issues to be considered in the future.

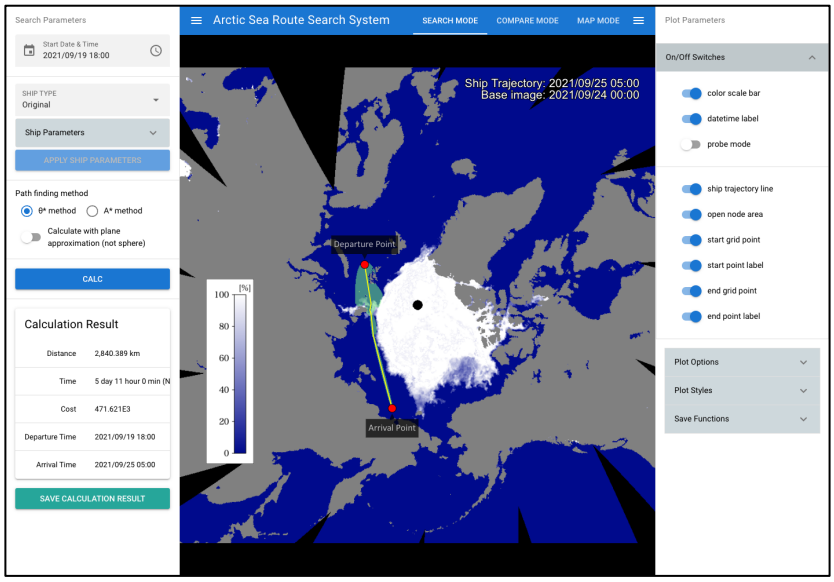

Figure 1. Web application of arctic sea route search system on the ADS web site.