

# The Nautical Cartographic Constraints and an Automated Generalization Model

Nada Tamer<sup>1</sup>, Kastrisios Christos<sup>1</sup>, Calder Brian<sup>1</sup>, Ence Christie<sup>2</sup>  
Greene Craig<sup>3</sup>, Bethell Amber<sup>3</sup>, Hosuru Madhu<sup>3</sup>

<sup>1</sup>Center for Coastal and Ocean Mapping/UNH-NOAA Joint Hydrographic Center, University of New Hampshire, Durham, NH, USA

<sup>2</sup>NOAA, Office of Coast Survey, Marine Chart Division, Silver Spring, MD, USA

<sup>3</sup>ESRI, Marine & Topographic Production Division, Redlands, CA, USA  
[tnada@ccom.unh.edu](mailto:tnada@ccom.unh.edu)

Current methods for nautical charts generalization are strongly human interactive and time-consuming. Significant amounts of effort are needed for generalizing, compiling, updating, maintaining, and consistency checking those products. The ideal situation would be a fully automated solution for generating products on demand, at the right scale, at the point of use, and directly from the seamless database, that respect all application specific constraints (i.e., Safety, Legibility, Topology, and Morphology). Such a solution would solve many related problems, minimize the time and effort needed for ENC production and support rapid update. However, regardless of the advancements in technology and the various research efforts, generalization tasks for nautical chart compilation are still performed mostly manually or semi-manually, where a likelihood of human error must be admitted. Furthermore, practice has shown that there is often a trade off among the various generalization constraints as fixing one violation may result in the violation of another constraint.

Towards this optimum goal, we are conducting a project that aims to investigate the previous efforts for automated map production, review the available relevant nautical cartographic standards and specifications, and extract and categorize the nautical chart generalization guidelines thereinto. These are subsequently translated into rules and defined in a template as conditions to be respected during the generalization process. According to a hierarchy level, a cost will be related to any violation according to its importance to the safety of navigation. Since fully satisfying all constraints seems infeasible, the optimal generalized chart should be the one with the lowest cost. For the implementation, a multi-agent generalization model is under development in the ESRI nautical environment that will utilize the template and the source data within the areas of interest to perform the generalization for the target scale (Figure).

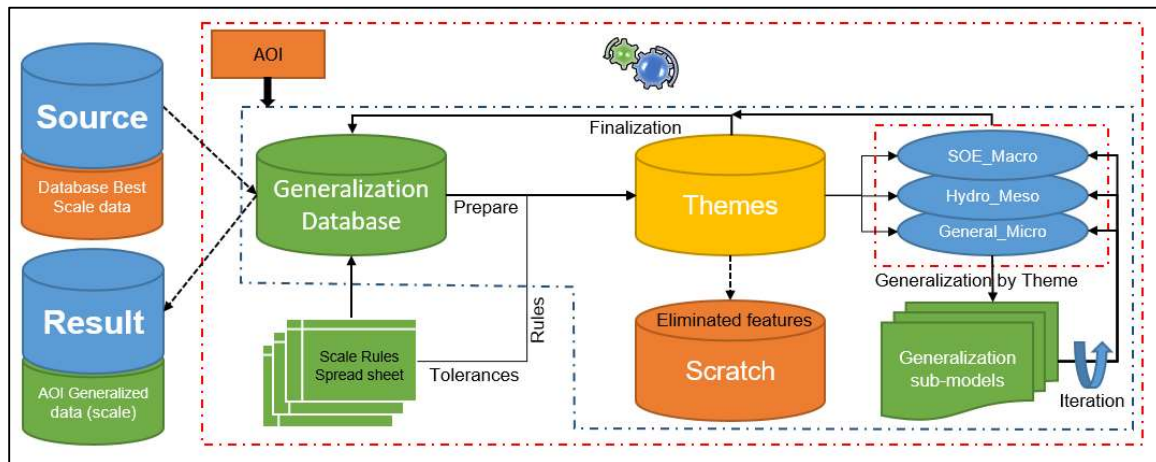


Figure: The concept of the nautical generalization model