

# **Synoptic Risk Assessment for Ship Passage and Hydrographic Uncertainty Representation**

**Brian R. Calder**

Center for Coastal and Ocean Mapping and NOAA-UNH Joint Hydrographic Center  
University of New Hampshire, Durham NH 03824, USA  
brc@ccom.unh.edu, +1 (603) 862-0526

## **Abstract**

Expression of the inherent uncertainty of hydrographic and cartographic data in chart products for surface navigation is, in general, poor. On most products, the only representation is a description of the age of the data (which means little to most users, and cannot be adequately assessed without detailed knowledge of when different technologies were adopted into practice), or at best some assessments such as CATZOC, which mostly describe what the hydrographers did, not what they know (or, more importantly, do not know) about the area. Consequently, models of ship transit risk (often in limited form, such as grounding probability or incident rate) that ignore the bathymetric component, or assume that the chart provides all available knowledge, can (potentially significantly) underestimate the effects of bathymetry on risk experienced.

As an alternative, a bathymetry-aware own-ship risk model is proposed, which accommodates presence or absence of bathymetric data, and includes such effects as measurement uncertainty, vessel parameters, and environmental variations. This model can be used to predict own-ship risk for specific transits in pre-voyage planning, estimate a predict-ahead uncertainty from a given position to provide real-time decision support tools, and (calibrated by AIS-derived statistical models of shipping) compute the overall risk for particular areas, which provides for an alternative statement of uncertainty in chart products that can be readily visualized even in static printed or electronic products. The model can also be used to assess resurvey priority, and to direct conduct of surveys.

The resulting toolset is designed as a library of risk-estimation software objects which can be configured to solve all of the described own-ship risk model estimation problems. The library could also be readily integrated with more general multi-ship environments to provide core risk estimation services, and readily adapts for multi-threading and multi-processing for computational efficiency.