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Fusing Information in a 3D Chart-of-the-Future Display

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DATA VISUALIZATION RESEARCH LAB

CCOM JHC

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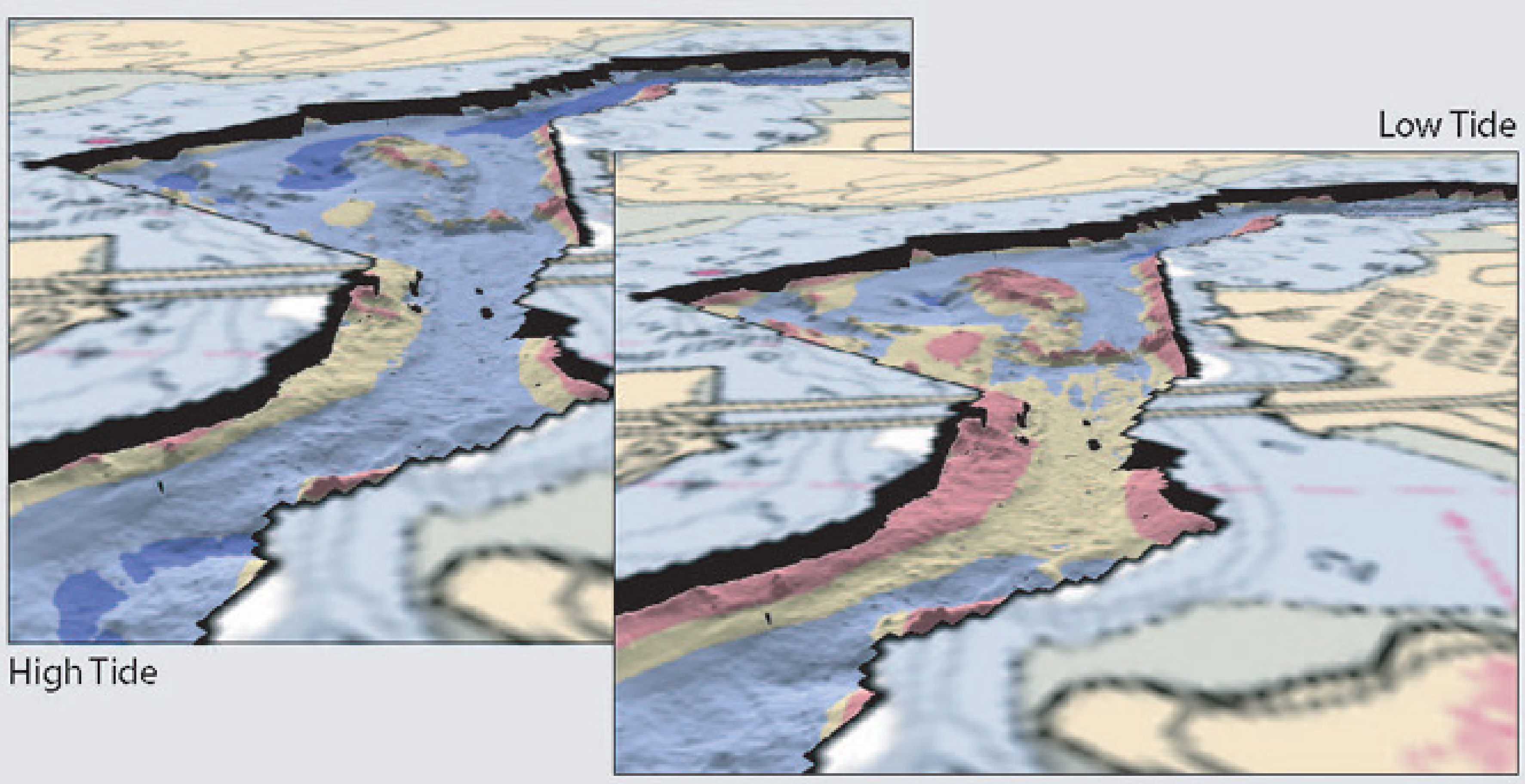
The goal of the "Chart of the Future" project is to take a revolutionary, rather than evolutionary approach to building decision support systems for the mariner. We pay attention to current ENCs as sources of functional requirements rather than as foundations on which to build. Our design strategy is to build proof-of-concept prototypes, and thereby take better advantage of new technologies such as inexpensive 3D displays. We carry out prototype development on our GeoNav3D platform, which is based on GeoZui3D, a flexible interactive 3D data visualization system supporting georeferenced and time-referenced data. With GeoNav3D installed in limited real-world environments, prototype elements can be evaluated against each other, against existing charting technology, and against emerging ENC technologies. Here we present two design concepts in prototype form.

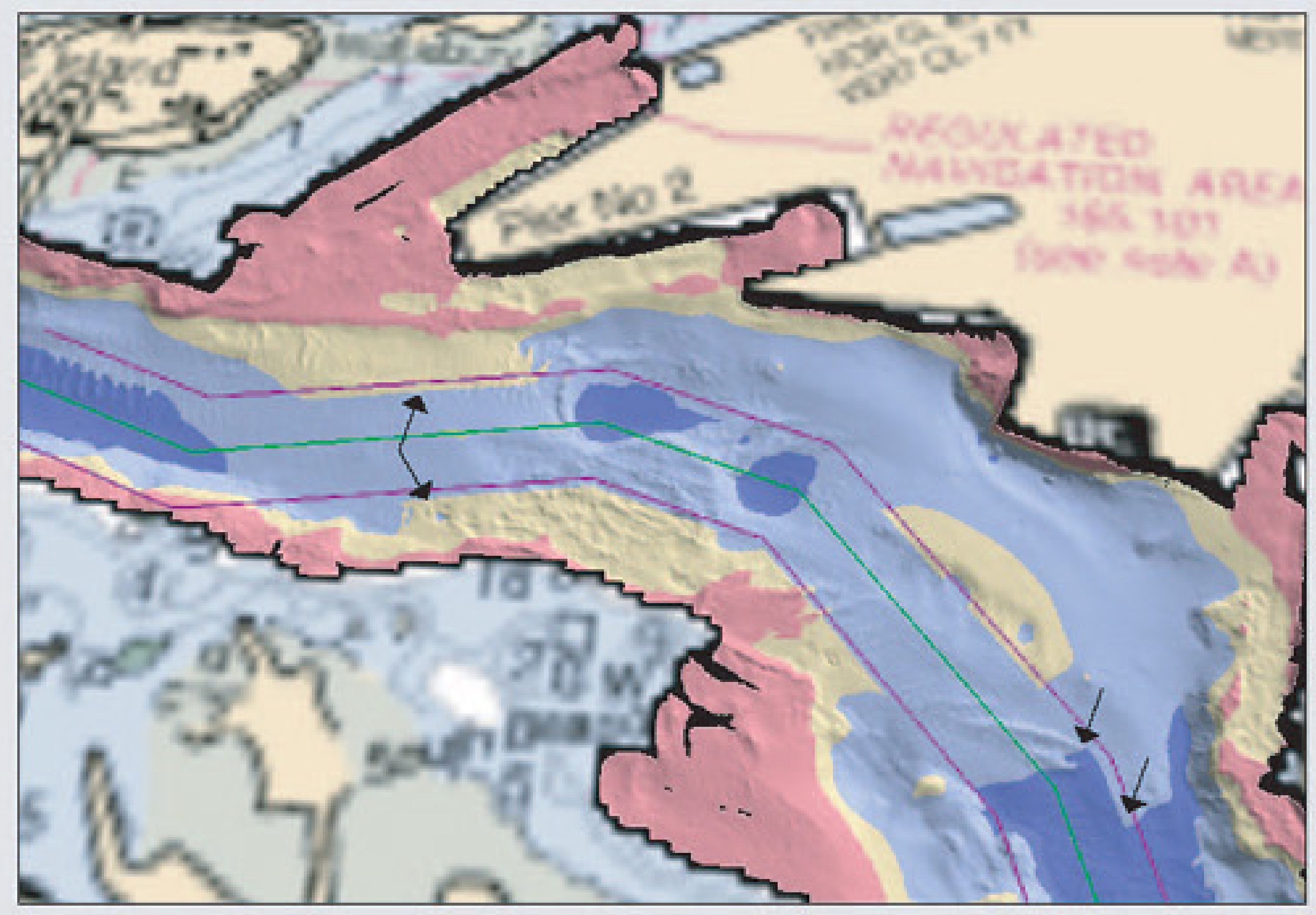
Fusing Tide, Depth, and Planning Information

In our design of GeoNav3D, we assume that the chart of the future will have available to it various forms of detailed information, including continuous bathymetry such as a navigation surface, real time tides, estimated currents, AIS information about other vessels, radar, and weather. GeoNav3D can display tides in real-time by continuously adjusting the color contours to take into account the estimated water surface based on modeled tides. Below is the Great Bay estuary, and the entrance to Little Bay from the Piscataqua River at the General Sullivan Bridge. The color scheme illustrates the under keel clearance by using blues for safe areas, yellow for warning areas, and red for danger areas. At high tide, a mariner can safely transit under the bridge. At low tide, the mariner must be cautious or elect to wait for higher tides.



Low Tide

High Tide

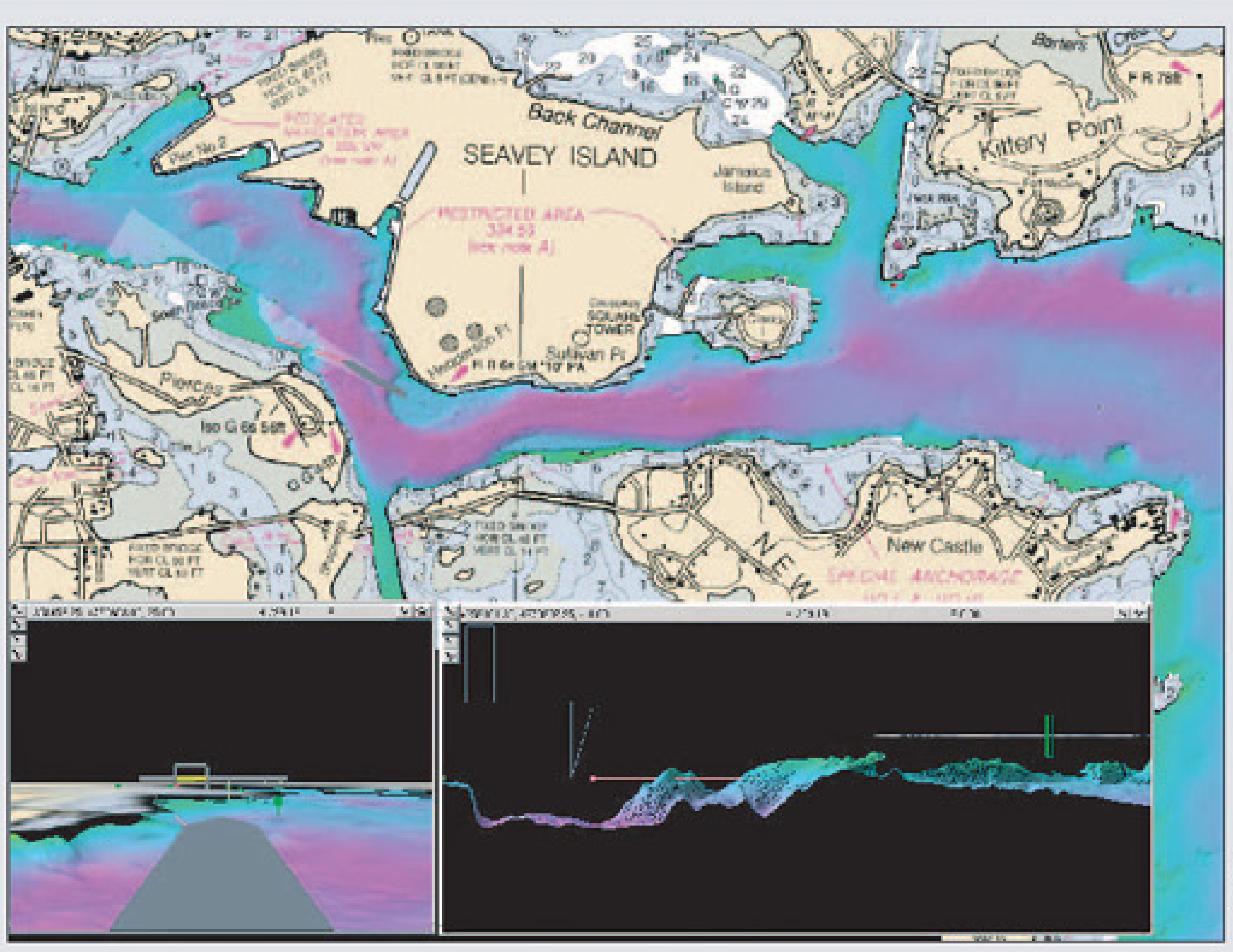


GeoNav3D also supports voyage planning through display of anticipated tides in a corridor along a planned path. The mariner can enter a series of waypoints and anticipated arrival times, and GeoNav3D automatically computes adjusted depths along a navigation corridor. Above is a navigation path plotted on the Piscataqua river. At the present time, the path passes through an area where the under-keel clearance is at a warning level (yellow zone outside the corridor). However, the under keel clearance is adequate when we expect to reach each waypoint, (blue zone inside the corridor). Note the discontinuities in color near the arrows, indicating the difference in time and tide inside the corridor.

Linking Multiple 3D Views

We expect the chart of the future to require multiple views, with each view specialized to support specific tasks. At left is a display that combines an existing chart with bathymetry, buoys, and a bridge. The plan view provides context for the two inset views, with information for addressing longer-term and larger-scale questions. The profile view is height-exaggerated and displays in wire-frame everything immediately in front of the vessel, for instant information about depth (the bottom) and height (bridges). The bridge view helps the mariner link real-world features seen out the window with charts and data displayed by the navigation system. It supports situational awareness and makes apparent the vessels and obstacles requiring the most immediate attention.

Plan View



Bridge View

Profile View

Information from distinct individual views must often be fused to make good decisions. GeoNav3D supports such fusion through various linking mechanisms. One such mechanism is a view proxy—a representation of one view within another. Another mechanism is the use of tethers that connect a view to its proxy in another view. Above, a view proxy appears as a headlight shining from the front of a vessel, representing what is visible in the profile view. At right is a prototype vessel traffic-control display with one view monitoring for collisions and the other following a fleet formation. Two proxies are shown, connected by tethers to the windows they represent. Other mechanisms are prototyped in GeoNav3D as well, including view coupling (for creating forward-up map views or object-following views like the bridge view and profile view) and a multi-view 3D mouse cursor.