



Technologies and Marine Navigation Challenges in Restricted Visibility and Fog

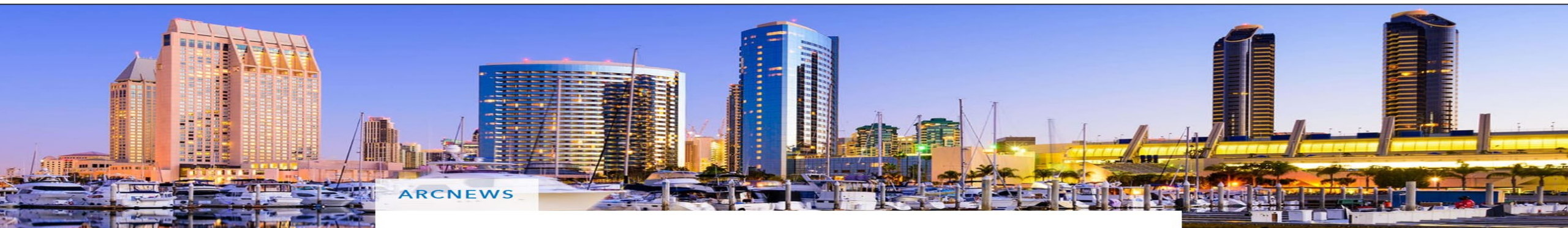
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HSRP Technologies Working Group

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Statement of the Problem

- During the winter months, fog is one of the main causes of ports closure due to restricted visibility.
- Today's precision aided navigation technologies can alleviate such a problem by providing the pilots with the needed tool to enable them to navigate through a restricted visibility condition.



How much do you think a jetliner pilot can physically see their way?



Image courtesy: <https://www.express.co.uk/travel/articles/1035694/flights-airport-pilot-plane-landing-night>



Image courtesy: TPG (<https://thepointsguy.com/guide/how-pilots-navigate/>)



Aircraft Navigation – It is always foggy up there

Commercial aircraft utilizes a few navigation systems to help guide the flight from point A to B. These navigation systems consist of:

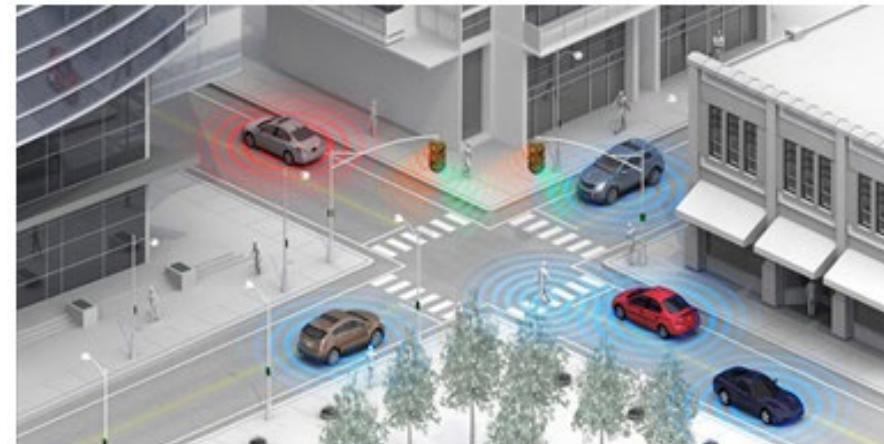
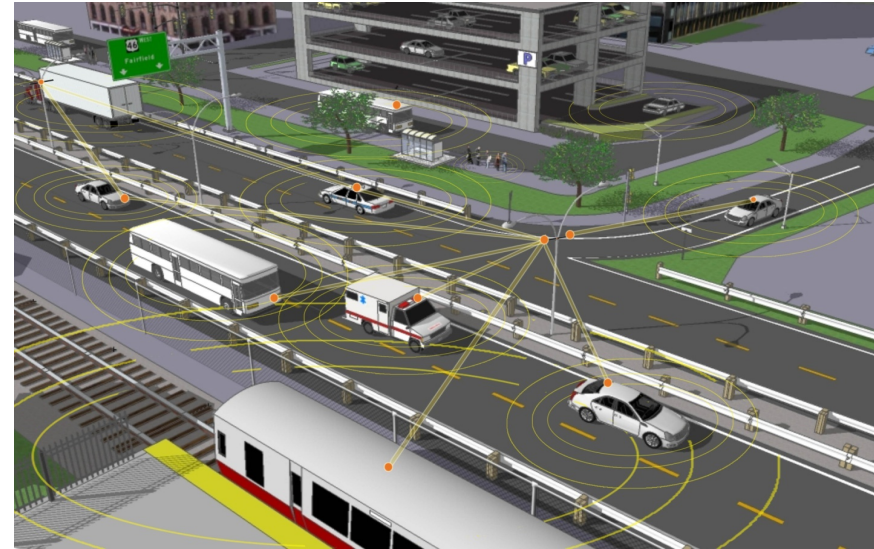
- Global Positioning System (GPS) - **is one of the primary navigation sources**
- Inertial Reference Systems (IRS)
- Radio Aids (VORs, DMEs, ADFs, ILSs)

if any one of these navigation systems fails, it's not a problem as there is lots of redundancy onboard. **Pilots don't get lost very often!**



Autonomous and Connected Vehicle is another example on current capabilities

GPS/GNSS and Vehicle Sensors are key to aided navigation during restricted visibility



Images courtesy Federal Highway Administration



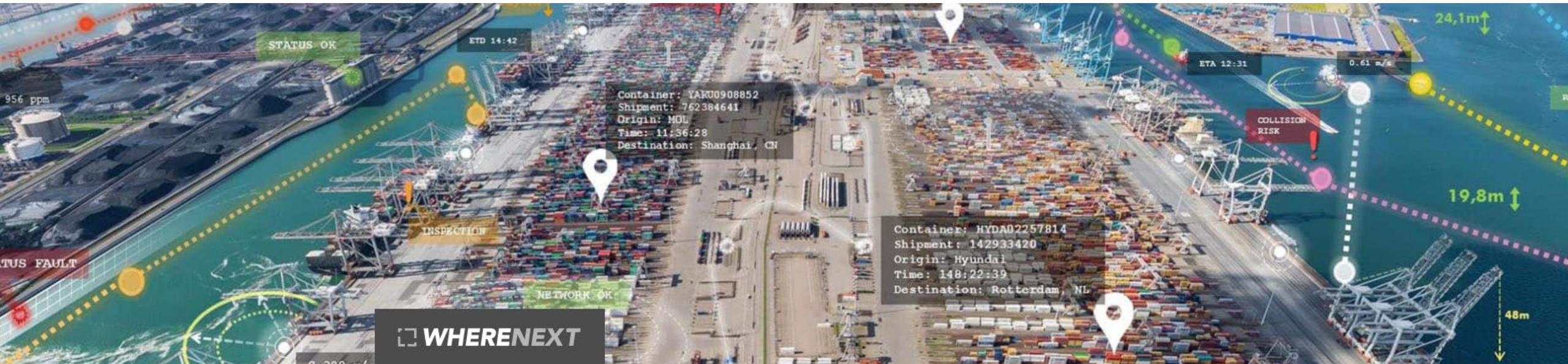
Navigation of Ships during Restricted Visibility is Possible Today



SPAN technology benefits the marine industry by combining GNSS positioning with velocity, attitude and heave data. This solution has 15 years of proven experience behind its ability to provide enhanced performance for hydrographic survey applications through 3D positioning output and accurate measurements even through extended GNSS outages.

“This will be the next man on the moon for the Port of Rotterdam”

"Erwin Rademaker, the program manager charged with ensuring that Europe's largest port can accommodate autonomous ships by the year 2030.



<https://www.esri.com/about/newsroom/publications/wherenext/rotterdam-autonomous-ships-and-digital-twin/>

The Netherlands has the best port infrastructure in the world, according to the World Economic Forum in 'The Global Competitiveness Report 2016-2017'



All it takes: Human and Machine to locate where you are

Basemaps ▾

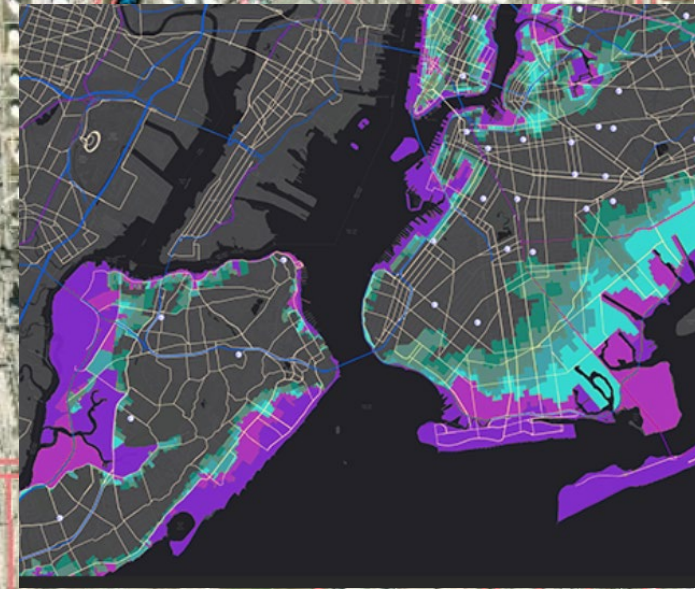
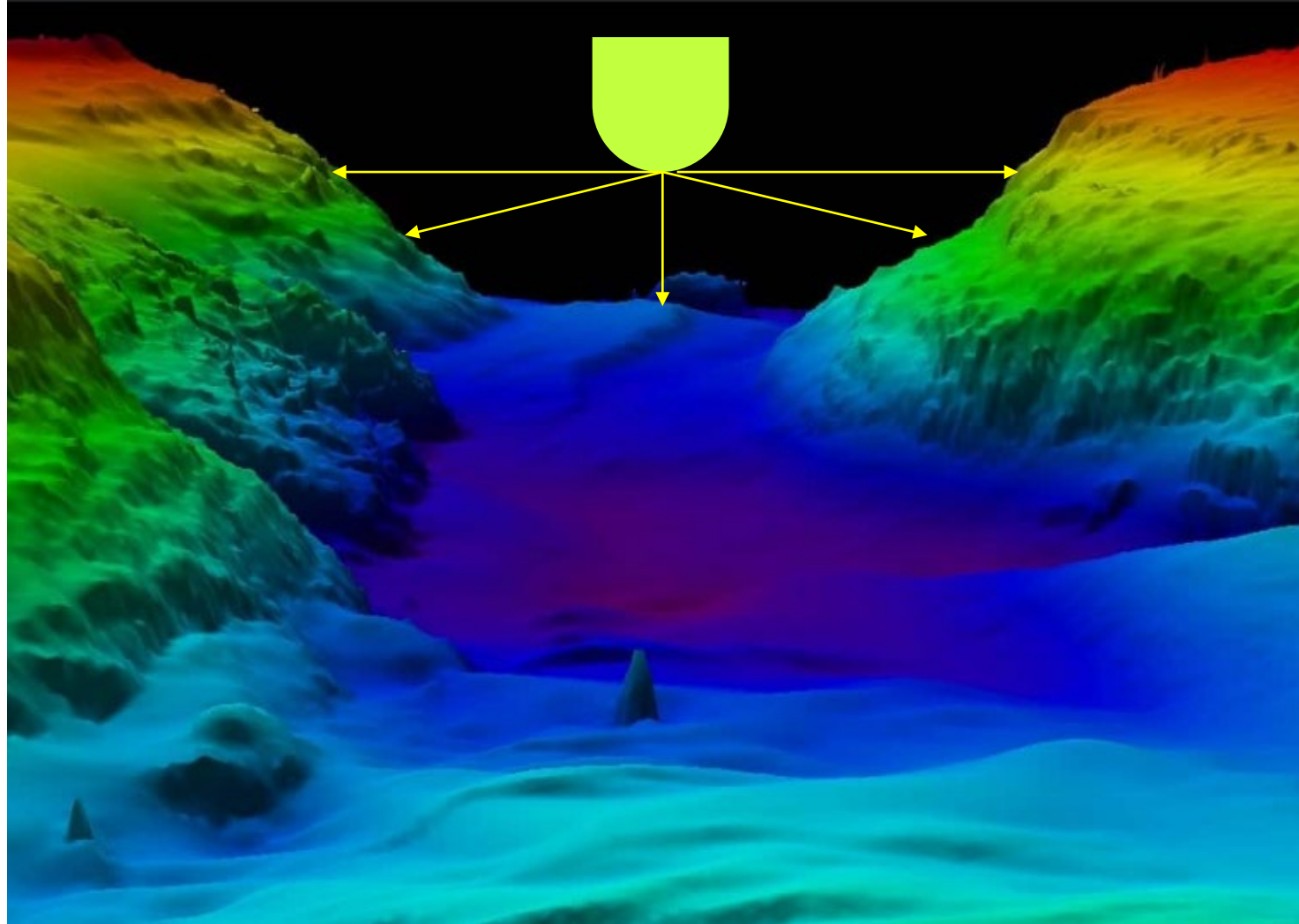


Image courtesy: <https://cohegis.houstontx.gov/cohgisweb/houstonmapviewer/> & esri.com



Port Bathymetric Map – is always needed



https://www.google.com/imgres?imgurl=https%3A%2F%2Fres.cloudinary.com%2Fg3eo-peru%2Fimage%2Fupload%2Fq_auto%3Alow%2Fv1538882271%2Fbathymetry-min_p70poz.jpg&imgrefurl=https%3A%2F%2Fwww.g3eo.com%2Fservices.html&tbnid=8spFKqGNplqz5M&vet=12ahUKewiltDhw5_pAhUK8awKHSg0AvcQMyhfegUIARCKAg..i&docid=X_nTpw1ycbLxnM&w=1000&h=702&q=bathymetry&ved=2ahUKewiltDhw5_pAhUK8awKHSg0AvcQMyhfegUIARCKAg

Technical Requirements To Enable Marine Channel Navigation During Fog

- Real Time Kinematic GPS/GNSS Receiver(s)
- Inertial Reference Systems (IRS) – *optional for small boats*
- Radar and cameras – *optional for small boats*
- Port High Definition Infrastructure Map (3D GIS Database)
- Port Bathymetric Map (Bathy Lidar/Acoustic Surveys)
- Application Software for Viewer/app