Overreliance on Modern Navigation Aids:
The Role of Traditional Methods of Navigation and Case Studies
GPS and “Radar Hypnosis”

- GPS becomes especially limiting when no other navigation techniques are used to verify readouts.
- The almost complete fixation on one instrument, to the exclusion of other data, disregards important principles of navigation.
- In most cases, it is the human element which causes a maritime incident, no matter how sophisticated the suite of electronic aids.
- “Radar hypnosis” was a recognized danger and this human frailty is no less apparent today with GPS.
A Generational Issue?

GPS versus the Sextant

Each method has its merits and there exists a human element in how modern navigational systems are applied.

Prime navigation principles are not replaced by new technology.

Proper Watchkeeping

Relies on three basic inputs

1. Bodily senses (primarily sight)
2. The complete suite of instrumentation
3. Training and experience
Principles of Navigation

I. The redundancy principle

II. Cross-checking with other navigation methods
I. The Redundancy Principle

Each electronic aid and navigational system should have a backup in case of failure.

The human senses as a backup to instrumentation.

Experience or gut-level instinct as the final catch-all.
II. Cross-checking and Verifying

Navigational tools should not be used in isolation.

- Identification of errors and faults
- Certainty based on multiple inputs
Will there ever exist a negotiated truce between old-school adherents of celestial navigation and the new generation of navigators?
1. **Point**
   at the celestial body (sun, moon, planet, star)

2. **Shoot**
   Initiate acquisition by pressing a button

3. **Fix**
   plot your position by USB cable from the device
The most advanced electronic systems are only as good as the individuals who use them.

If navigation officers fail to realize there are other tools at their disposal, the ship may eventually encounter difficulties.

Human errors are introduced by:

- fatigue from long working hours
- unfamiliarity with latest generation devices
- overreliance on certain instruments to the detriment of others
- lack of awareness of how these instruments interrelate
On June 10, 1995, the ship grounded on Rose and Crown Shoal ten miles East of Nantucket Island while en route from Bermuda to Boston.
Graphic representation of the GPS display at 2000 hours on the night of the grounding. The arrows show the DR (dead reckoning) and SOL (faulty solution). Source: http://ti.arc.nasa.gov/m/profile/adehani/Grounding%20of%20the%20Royal%20Majesty.pdf
Case Study I - Actual and intended route of the Royal Majesty
Case Study I – Royal Majesty

The reflected echo from the "AR" buoy matched the expected location of the "BA" (entrance) buoy.

Source: http://ti.arc.nasa.gov/m/profile/adegani/Grounding%20of%20the%20Royal%20Majesty.pdf
Case Study I – Royal Majesty

- Cursory Loran-C readings were taken at the beginning of the voyage to verify the accuracy of the GPS unit.
- Loran-C receiver was of the variety where TD measurements are automatically translated to digital Latitude and Longitude readings.
- Continued comparisons would have been a simple matter to achieve.

Radars

Radar **map** is displayed as derived from the GPS data

Radar **image** relies on what the radar scanner sees

Underlying the radar map is the actual radar image

Officer failed to:
1. Run a second radar set on longer range or
2. Inter-switch the single radar to a longer range
Case Study I – Royal Majesty

Light patterns and sound signals for buoys were not sought and recognized.
Fathometer

Restricted use of the fathometer is no longer necessary when a digital readout is possible

Source:
http://www.marinebio.net/marinescience/01intro/tomeas.htm

Source:
The investigation did not reveal whether this channel was being monitored.

Why would the second officer have assumed there existed needless conversation on a restricted frequency when his ship was being hailed?
Lookouts

The port lookout reported blue and white water to the officer of the watch, who acknowledged but did not verify the sighting, and did not act accordingly.
Navigational Holding Pattern

Cruise ship ran aground two miles off the Cape Cod Canal in dense fog, forcing the evacuation of 680 passengers

- Under these circumstances the ship is expected to “mill about smartly,” turn small circles, or perhaps go to anchor
- Radar was not used to take bearings and ranges to land promontories
- A ship is never just “parked” somewhere
Case Study II – *Bermuda Star*

Estimated grounded position

Entrance to channel
Autopilot Failure

Tanker grounding on semi-submerged coral at full speed, in daylight, with running radar, and the watch officer and lookout present.

The vessel was reportedly swept further westward onto the reef by seas associated with heavy weather.
Autopilot Failure

The autopilot had malfunctioned after an hourly position fix with the GPS had been taken.

The navigation watch should have:

- taken GPS position fixes more frequently in proximity to "land"
- supplemented GPS readings with piloting techniques
Case Study III – *Kora*

Quita Sueño Bank and grounded position of the *Kora* at Lat 14° 24.22 North, Long 081° 06.55 West

Source of grounded position: Author
Conclusions

The modern bridge environment is an integrated system of instruments that speak with each other.

Intuitively, a second GPS is commonly purchased from a different manufacturer for the reason of creating redundancy.

Perhaps dual monitoring GPS receivers would be feasible as well, where a discrepancy of more than one nautical mile would trigger an alarm.
The human-machine interface and the interrelated nature of communications among navigation aids must be better understood, and taught.

The compartmentalized way of teaching and thinking must be reappraised.

Navigation practices should be instructed in a holistic fashion.
Conclusions

Instruct

• how instruments communicate with each other

• how they obtain their data

• how the readouts should be interpreted
Conclusions

New Habits

- Verification by another suitable method will be required, especially with the dominant position of importance GPS now holds.

- Real-time, pre-departure bridge equipment check list could be instituted using a laptop or tablet program.

- The revamped electronic sextant and apps should be integrated into the suite, not merely smuggled on board.

- Questioning and verification of data should be encouraged and rewarded.