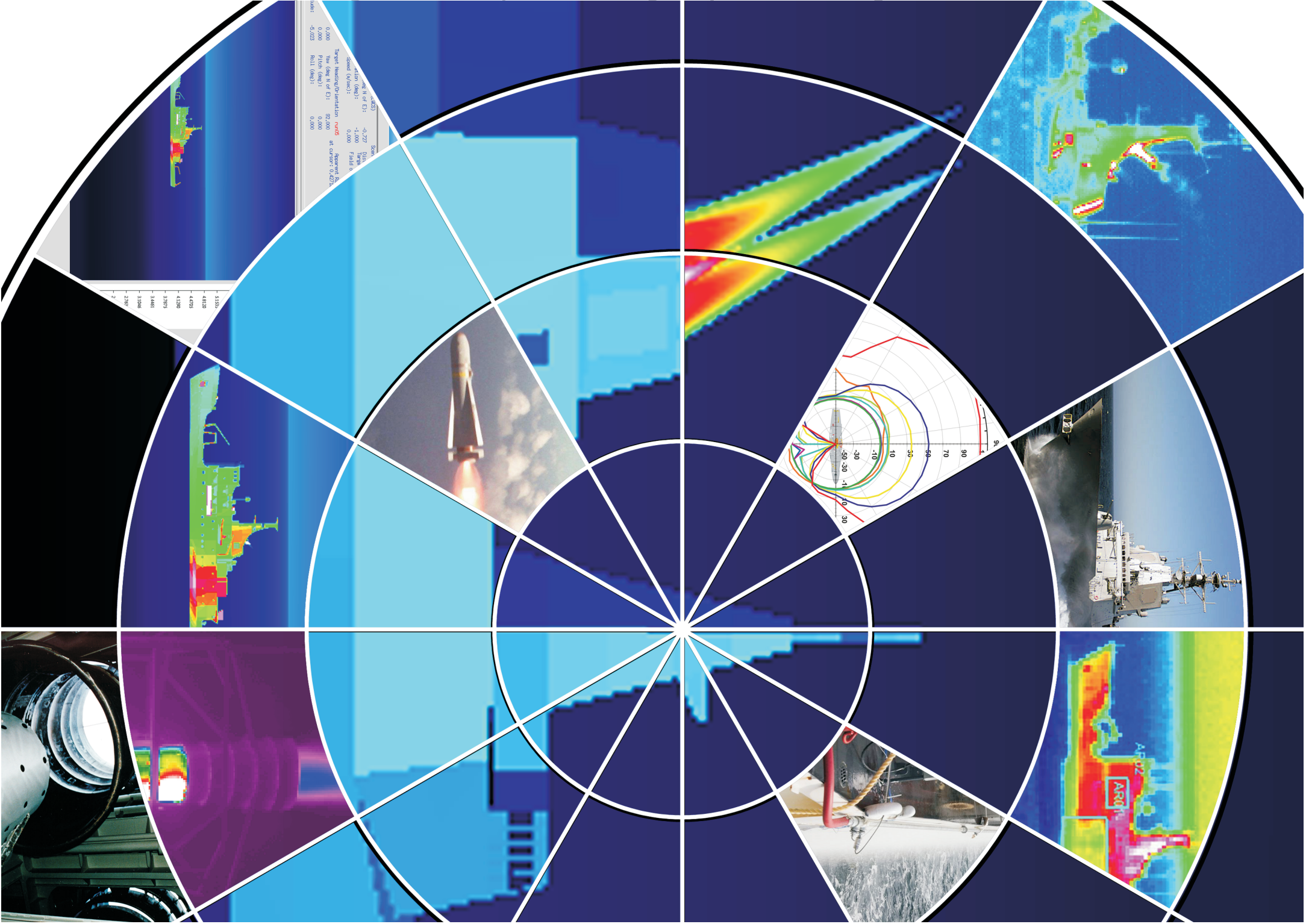


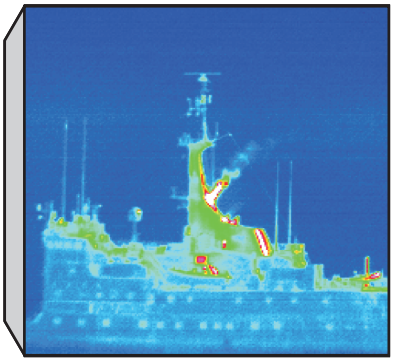
Davis

Naval Infrared Signature Management

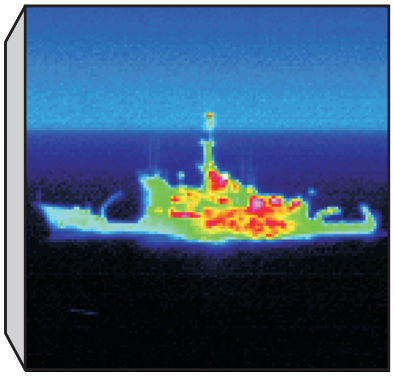
Anti-ship missiles (AShMs) are a significant threat to modern warships and were used successfully in the 1982 Falklands War, in 1987 in the Persian Gulf, and in the 2006 Israeli Hezbollah war. Many modern AShMs, such as the Penguin, SLAM, and NSM, use infrared (IR) homing in the terminal phase of engagement.

IR self-protection is essential to the survivability of modern warships. Suppressing ship IR signature reduces missile lock-on range, making a missile hit less probable, and providing the crew with more time to launch decoys.

The IR signature of a ship originates from both internal and external sources. Internal sources include the hot engine uptake metal and exhaust, and heated interior compartments. External sources include skin heating, reflections, and contrast with the background. Internal and external sources must be addressed in a balanced manner during the design of the ship.

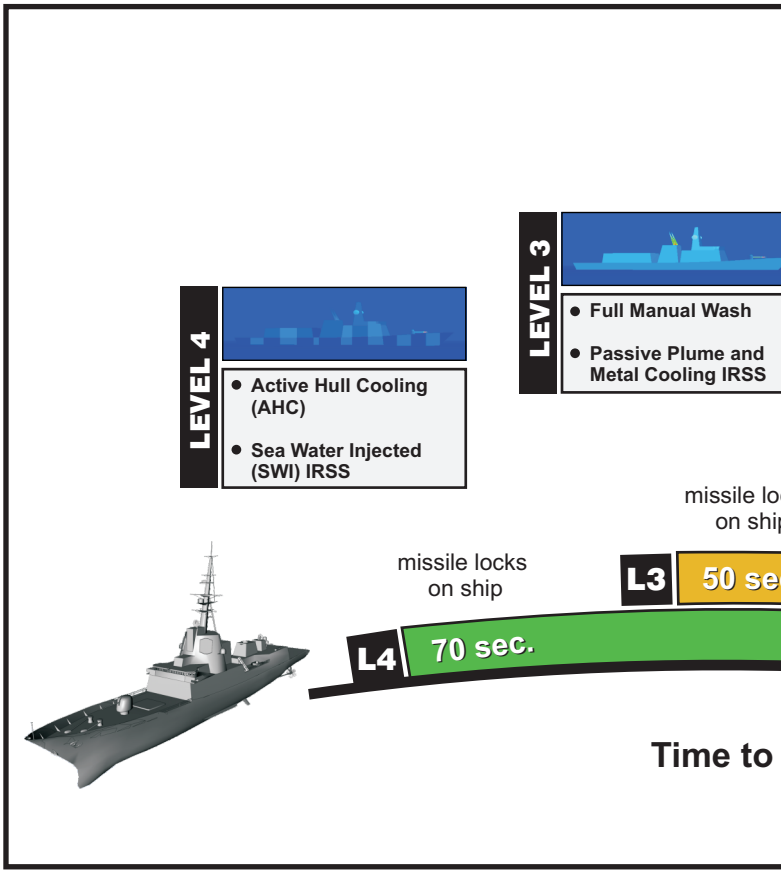


- **Exhaust gas impingement**
- **Engine exhaust plume**
- **Solar glint**



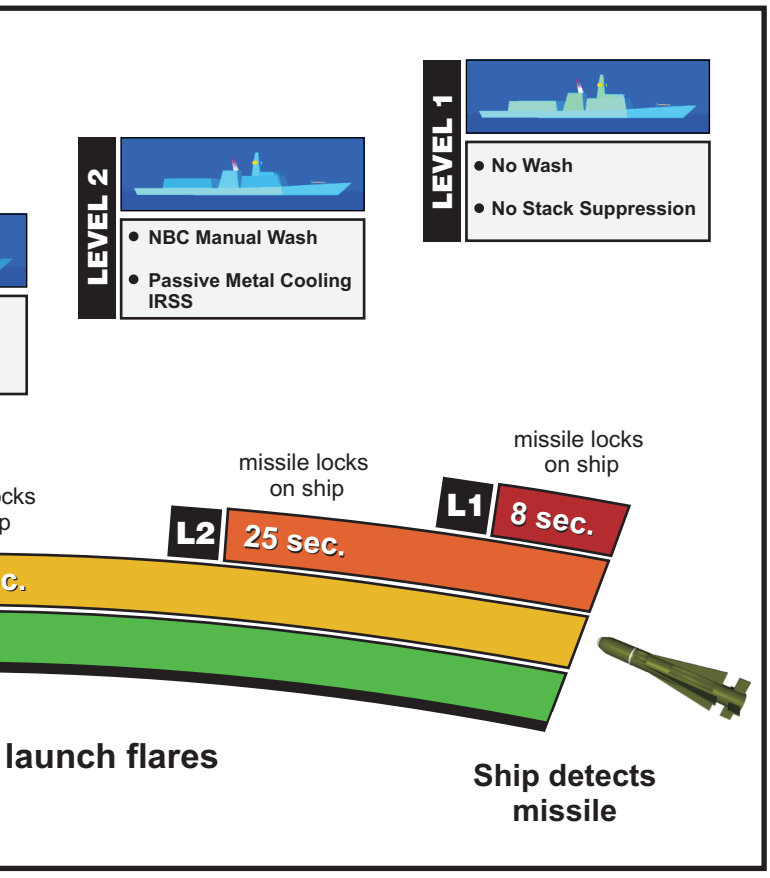
- **Heated ship skin**
- **Reflection of background radiation**
- **Reflection of solar radiation**
- **Contrast with background**

Besides the application of insulation and low emissivity paint, there are two IR suppression technologies which are applied to a naval ship: exhaust stack IR suppressors; and skin cooling. Each of these technologies can be specified with various levels of performance. Exhaust suppression can be specified to achieve: only metal cooling; metal and passive plume cooling; or metal and active plume cooling. Skin signature reduction is achieved using a water wash system which can be specified to achieve: NBC coverage; full coverage with manual control; or full coverage with active control.



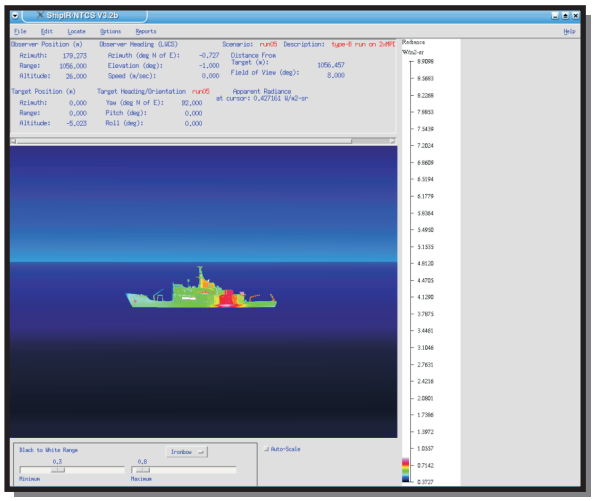
Following the guideline that internal and external sources of IR signature should be addressed in a balanced manner, DAVIS has grouped exhaust suppression and skin cooling technologies into four levels: Level I corresponds to no suppression; Level II to exhaust metal cooling and NBC wash; Level III to metal and passive cooling and full wash; and Level IV to metal and active plume cooling and active wash.

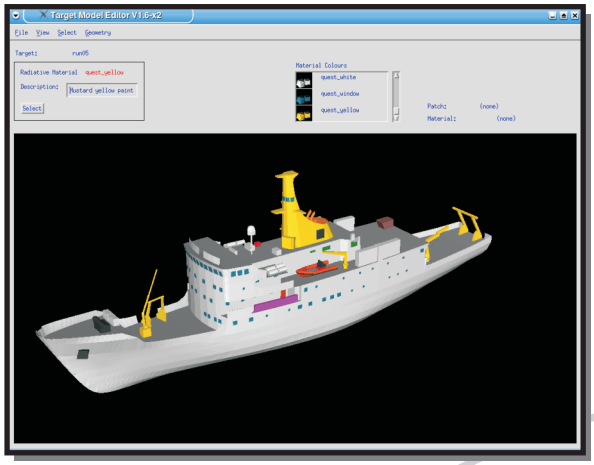
The selection of which level of suppression to apply to a ship is based on the sophistication of the IR threat which may be encountered, and the likelihood that the ship will come into harm's way. Modern IR seekers, like that used by the Penguin missile, detect IR energy in Band IV, for which the plume is visible – so clearly a Level III solution is appropriate. Next generation seekers like the SLAM and NSM use imaging technology – requiring Level IV suppression to provide an effective reduction in susceptibility.



A reduction in IR signature will cause a reduction in the range at which the missile can lock on to the ship. A ship which detects a missile as it comes over the horizon has more time to react and launch flares if the missile lock-on range is reduced.

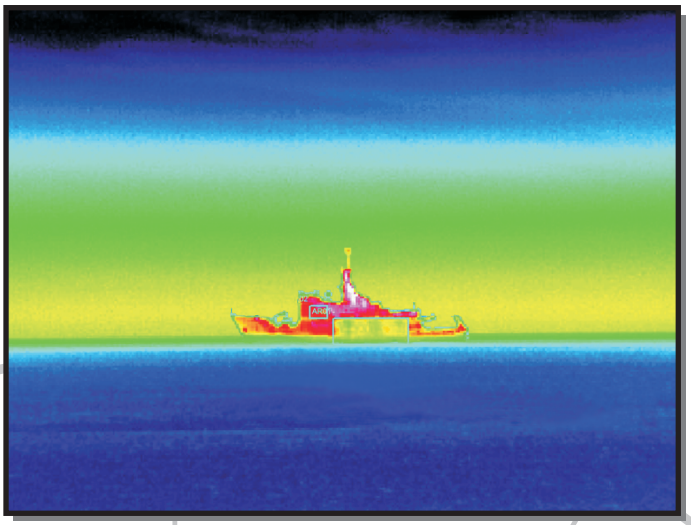
ShipIR/NTCS, the NATO standard and only U.S. Navy accredited IR signature prediction code, is used during ship design to assess the contribution of various IR sources to the total ship IR signature, and to predict the effectiveness of suppression technology. ShipIR is actively used by over 30 clients worldwide, including government naval research labs and ship architects.

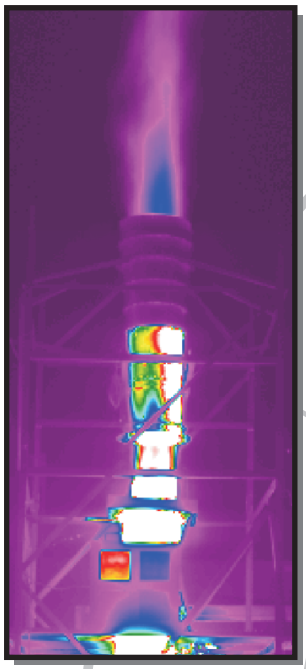




Top: User interface of ShipIR/NTCS;
Bottom: Target Model Editor module of ShipIR/NTCS.

DAVIS has IR suppression technology operational on over twenty classes of warship worldwide. The DAVIS Eductor/Diffuser and DRES-Ball stack exhaust suppressors provide effective Level III protection. Active plume cooling is achieved with the DAVIS Sea Water Injection (SWI) system, which can augment the E/D, or can be applied to a side exhaust system. The DAVIS Active Hull Cooling (AHC) system controls the flow of sea water onto the ship hull and superstructure during a heightened threat or combat situation in order to blend the ship into the background when viewed in IR. These advanced Level IV systems exist today and have already been delivered to various naval clients around the world.





Left: Sea Water Injection (SWI) system tests conducted on the Eductor/Diffuser; Top Right: MWIR measurement of ship with AHC on hull section (~ 10 km range).

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