July 2007, Issue 13

Davis

KDX-III ADVANCED IR SUPPRESSION

The ROK Navy Aegis class Destroyer, KDX-III, has taken delivery of the most advanced DAVIS Infrared Signature Suppression (IRSS) technology. Using an automatic controller which monitors the surrounding environment, the advanced system actively controls IR signature in order to blend the ship in with the background.

DAVIS has augmented the Eductor/Diffuser, which passively mixes cool ambient air into the engine exhaust stream, with an active sea water injection (SWI) system. The SWI system injects a fine water mist into the exhaust stream in order to further cool the exhaust gas by water evaporation. Ship skin signature is controlled by an active hull cooling (AHC) system which automatically controls the flow of water to a large array of sprinklers.

The controller for the advanced IR suppression systems is the Onboard Signature Manager (OSM) which calculates the optimal temperatures for the ship hull and superstructure given present environmental conditions. OSM builds on the NATO standard IR signature prediction code, ShipIR/NTCS.

The IR suppression systems for the KDX-III were selected by the ROK Navy after a thorough cost-benefit analysis which was conducted using ShipIR/NTCS throughout the basic and detailed design stages of the ship.

Conceptual rendering of KDX-III.

FOCUS

We have seen widespread adoption of our IR and underwater ELFE signature suppression technology over the past 5 years. IRSS systems are now installed on over 20 different classes of ship worldwide. ASG systems are now in use by 7 different countries on both surface ships and submarines.

We have continued to develop both IRSS and ASG technology. Active IR suppression systems like engine exhaust Sea Water Injection (SWI) and Active Hull Cooling (AHC) have recently been delivered to several naval platforms. New hyper-mixing nozzles have been developed to provide enhanced plume signature reduction in less space. A new 50A version of ASG has been developed and delivered to customers.

Indications are that advanced stealth technologies will be adopted by leading navies around the world in the coming years as the threat technology also continues to improve.

PKX STEALTH PATROL BOAT

DAVIS has completed the design and manufacture of the complete exhaust systems for the LM500 gas turbine propulsion engines on the ROKN PKX patrol vessel. Each exhaust system incorporates a sea water injection (SWI) system which cools both the exhaust duct metal and plume, providing effective IR signature reduction.

The exhaust systems exit the ship through the hull and were designed to ensure that the backflow of sea water into the duct from rough seas does not adversely affect engine performance.

Conceptual rendering of PKX.

LHD-8

Northrop Grumman Ship Systems (NGSS) has recently completed the installation of LM2500 gas turbine main propulsion engines on the LHD-8 amphibious ship. The high exhaust gas temperature of the gas turbines compared with the previous steam turbines, raised concerns during the design stage that mast antennae would reach temperatures which were out of acceptable range. DAVIS was contracted by NGSS to deliver a complete solution to the antennae impingement problem in three phases.

First DAVIS conducted a thorough analysis of plume trajectory both analytically and in CFD to determine the requirements for plume temperature at the exhaust stack exit. Second, a plume cooling system was designed and scale tested to achieve the required plume temperatures. Finally, the devices were manufactured and delivered to the NGSS yard for installation.

Close-up of exhaust system on LHD-8.

BRIEF UPDATES

- Delivery was completed in 2006 of the LM2500 gas turbine intakes/uptakes and IRSS systems for all three ships of the Indian Navy Shivalik (P17) class of frigates.
- In 2006 IRSS systems were delivered for the last of five New Norwegian Frigates.
- Delivery was completed for the IRSS systems for the fourth U.K. Type 45 Destroyer in 2006.
- DAVIS has signed a contract with DCN to provide IRSS devices for the FREMM frigate.
- DAVIS has completed delivery of both vertical and horizontal exhaust and IRSS systems for the first ship of the Polish Navy Corvette class.
- Delivery of IRSS systems for the French and Italian Navy Horizon frigates was completed in 2004.
- IRSS units were delivered to Fincantieri for the new Italian Aircraft Carrier, Cavour class.
- DAVIS participated to sea trial Q305 in Halifax during May 2007. This was the first collaborative measurement trial involving Defence Research & Development Canada (DRDC) Atlantic, DAVIS, and the U.S. Naval Research Laboratory (NRL) under a new US/CA bilateral agreement. The purpose of this trial was to measure the performance and effectiveness of the DAVIS SWI and AHC systems now installed on CFAV Quest. Representatives from NSWC (Carderock) and Raytheon (IDS) were in attendance to observe the latest technology in naval ship infrared suppression.

ASG UPDATE

Active Shaft Grounding (ASG) continues to be an important product at Davis. Since 1996 Davis has sold over 100 200-Amp ASG units. Products have been delivered to several US navy shipbuilders for installation on the Virginia, Arleigh-Burke, and San Antonio class ships. As well, Davis is now supplying the US Lewis and Clark and the new DDX-1000 class ships. Overseas, installations have been performed on the UK Astute submarines, the Norwegian Nansen frigates, and the Korean KDX-III destroyer.

The previous newsletter reported the start of the design of a new 50-Amp ASG model. That design has been completed and is now in production. Nine units have been delivered to date. This unit is also military qualified, mostly to European standards. It operates from 120 Vac, single phase.

Presently, Davis is working on an upgrade to the 200-Amp ASG unit. This upgrade will add improved monitoring capabilities and make the unit more environmentally friendly in terms of materials incorporated in the unit. The last 20 years have seen an increase in the number of prohibited substances on military vessels and the re-design will take this into account. The improved monitoring capabilities are the result of incorporating a microprocessor into the ASG unit to provide a digital connection to centralized monitoring equipment via RS-232, Ethernet, or other ship network. Furthermore, additional diagnostic capabilities will be available directly from the front panel without opening

the unit. This enhancement should greatly simplify any required maintenance.

Strong ASG sales are expected to continue as other navies increasingly become aware of the underwater electromagnetic threat.

50-Amp ASG unit.

EMPLOYEE PROFILE

Paul Sutton, Lead Hand, Welding & Assembly Technician

Paul was born in England. He moved to Canada at a very young age and was raised in the Montreal area. Paul joined Davis in 1989 as a welder, fitter. During his tenure with Davis, Paul has been involved in many projects. Paul's capabilities have provided Davis with many years of successful development work as well as the expertise to help lead others on the completion of these projects.

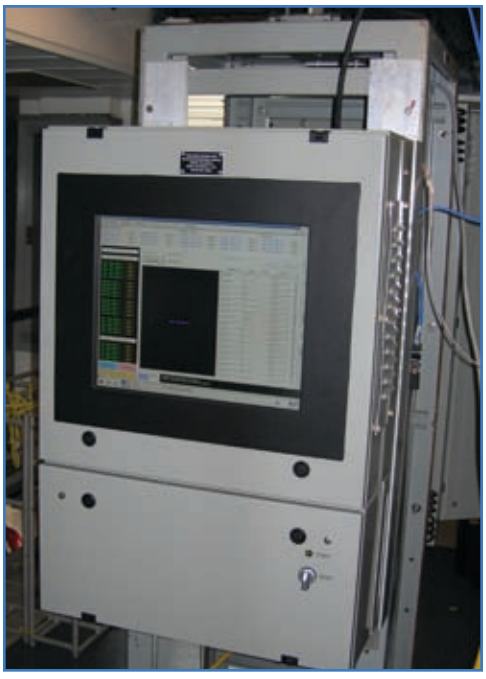
Paul, who lives with his family in Orleans, is an avid scuba diver, and enjoys the outdoors with weekends away camping. In addition, Paul is known to frequent clubhouses after a game of golf.

NEW PRODUCT - ONBOARD SIGNATURE MANAGER

The Onboard Signature Manager (OSM) is a control console which manages and controls active IR signature suppression systems like engine exhaust Sea Water Injection (SWI) and Active Hull Cooling (AHC). The OSM software development has been separated into two phases. Phase I comprises the control functions for SWI and AHC, and Phase II will provide real-time prediction of whole ship IR signature in the current operating environment. The console uses a touch sensitive graphical display screen for user operation, and also interfaces directly with the machinery control system.

To date OSM has been successfully integrated into the KDX-III, Polish Navy Corvette, and PKX ship classes. OSM is also installed on the Canadian research vessel, CFAV Quest, to be used to test its performance and validate the future release of a real-time IR signature prediction module.

Above: OSM user interface;
Right: OSM main control unit.



SHIPIR/NTCS UPDATE

Significant progress has been made since the last update in the Davis Newsletter no. 11 (September 2002). As part of NTCS (v3.1), specular multi-bounce and bi-directional analysis features were added to existing multi-bounce diffuse and single-bounce specular surface radiance model, in addition to a new sky model grid formulation near the horizon, incorporation of a new sea roughness model (Shaw and Churnside, 1997) to account for the effects of air-sea temperature difference, and a new 2nd-order slope shadowing effect near the horizon.

Upgrades in NTCS (v3.2) focused specifically on the ship thermal model with a new mass/energy transfer model for atmospheric condensate (areas of the ship radiating to temperatures well below the dew-point), a new directional irradiance model which maps secondary solar reflections from the background in both azimuth and zenith angles, and a new high-Reynolds wind convection model (10^6<Re<10^9) based on the work of Fraedrich and Rundquist (US Naval Research Laboratory, 2004). As shown by Figure 1, these improvements when combined have resulted in a milestone improvement in the accuracy of ship surface temperature prediction. These and other important model validation results from NTCS (v3.2) were presented at the 1st International Target and Background Modelling Workshop (Vaitekunas 2005).

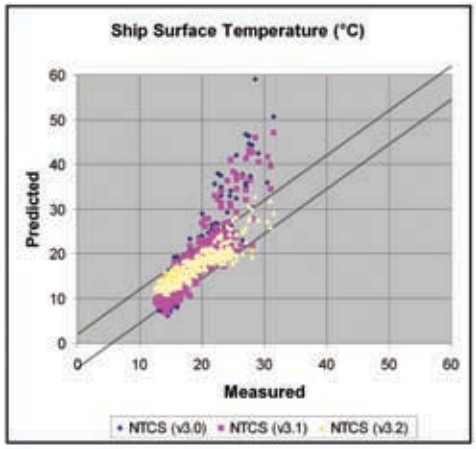


Figure 1: comparison of ship surface temperature predictions using NTCS (v3.2).

The Linux version of NTCS (v3.2) now has an off-screen rendering feature that allows multiple instances of `xntcs` to run simultaneously on the same `X` display. The US Naval Research Laboratory has been using this new feature on their Linux cluster to dramatically increase their throughput of ShipIR to an anti-ship cruise missile simulation program (CRUISE_Missiles). Ongoing developments in NTCS (v3.3) have included a new partial cloud sky model and a spectral viewing/analysis feature (see Figure 2).

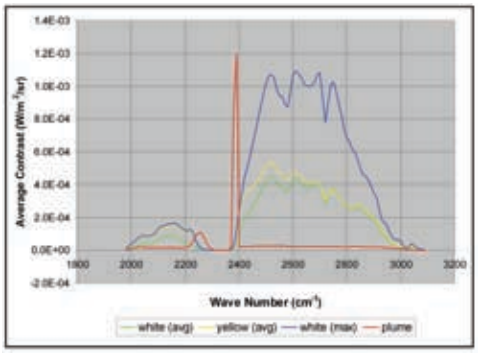


Figure 2: sample spectral analysis (v3.3).

BRIEF UPDATES

- ShipIR/NTCS has received a total of four US Navy accreditations: IR signature prediction of the DDG class of ships (NAVSEA PMS-400, Mar. 2001), DDX Preliminary Design Review (Northrop Grumman Ship Systems, May 2004), DDX Critical Design Review (Northrop Grumman Ship Systems, May 2005) and DDX Live Fire Test and evaluation (NAVSEA PMS-500, Nov 2005). These accreditations are a direct result of ongoing work at the US Naval Research Laboratory (NRL).
- A number of organizations have recently joined the worldwide network of NTCS users: TUBITAK UEKAE (Turkey), Galileo Avionica (Italy), Angle Inc. (USA), Raytheon Missile Systems (USA), and Korean Aerospace Industries (KAI).
- The Maritime Platforms Division in Melbourne (part of DSTO), is using ShipIR/NTCS to evaluate the IR signature of the two Air Warfare Destroyer (AWD) designs: the Evolved Design by Gibbs & Cox, Inc. (selected in August 2005) and the Existing Design by Navantia (F100 Frigate announced in May 2005).
- For the 2nd year, Davis will co-sponsor an International IR Target and Background Modelling & Simulation Workshop to be held in Toulouse, France during the week of 25–28 June, 2007. Dr. Vaitekunas will be presenting a paper on the analysis of climatic data for use by OSM and will also host a 1-day tutorial training session on NTCS.

W.R. Davis Engineering Limited
1260 Old Innes Road, Ottawa, Ontario, Canada, K1B 3V3
Web: www.wrdavis.com, Email: info@wrdavis.com, Tel: (613) 748-5500, Fax: (613) 748-3972