CMST Capability Statement

Ship Hydrodynamics Measurements

CMST conducted ship squat and wave-induced motions trials on 11 bulk carriers and tankers transiting Torres Strait

Ship squat was measured on 16 deep-draft containerships entering and leaving Hong Kong harbour

Ship squat, wave-induced motions and manoeuvring

CMST is able to measure ship motions extremely accurately using Real-Time-Kinematic (RTK) GPS technology. We typically use three receivers on each ship, to measure the absolute three-dimensional motion of the ship in earth-fixed coordinates. A shore-based receiver is also set up nearby, to provide GPS corrections to the shipboard receivers. In this way, horizontal and vertical accuracy of each ship receiver is in the order of 20-30mm.

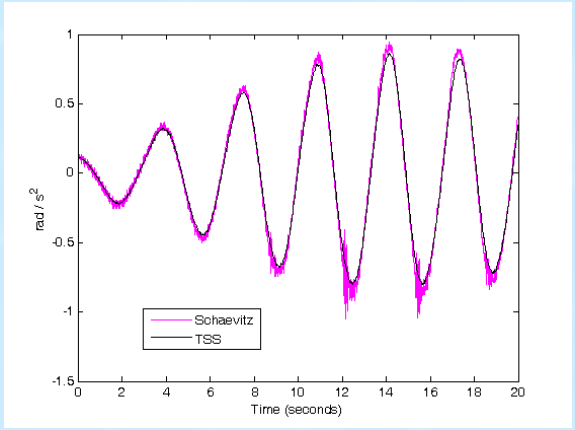
We work closely with Curtin's GNSS Research Group, who have developed internationally-recognized GPS positioning algorithms. This ensures that high accuracy can be maintained even with less-than-ideal satellite coverage.

When combined with measured tidal data or the measured motions of an escort vessel, ship squat (vertical movement relative to the rest position) can be determined.

Applications of RTK GPS measurements on ships include:

- Measurement of dynamic draught, including effects of squat, heel and wave-induced motions in shallow water
- Validation of under-keel clearance management practices
- Deep-water seakeeping trials
- Manoeuvring trials
- Motions of moored ships due to long waves in harbours

Measuring the motions of a crayfishing boat in waves, using CMST's inertial measurement system



Cross-checking roll accelerations between inertial measurement unit and linear accelerometers

Motions of small-to-medium vessels

CMST has over 20 years' experience in measuring wave-induced motions of small-to-medium vessels, using inertial measurement units combined with synchronized linear accelerometers. This setup allows independent cross-checks to be performed to ensure that all sensors are working correctly.

A combined inertial / GPS-corrected unit may also be used where absolute positioning is required.

Wave-induced motion trials are normally performed adjacent to a public waverider buoy, and the wave data obtained afterwards from the relevant government department. Waverider buoys may be temporarily deployed if no public wave buoy is available in the area.

Typical reasons for performing motions trials include:

- Comparing ship motions (especially roll and vertical accelerations) against standard motion criteria
- Calculating ship motion parameters empirically (e.g. roll damping and roll inertia) in order to more accurately predict motions in all seastates
- Diagnosing perceived seakeeping problems (e.g. excessive roll or slamming)
- Advising on hull design changes to improve seakeeping performance

Wake produced by a recreational vessel, being measured by CMST's pressure sensor waverecorder mounted on Quarry Point pilon, Perth.

Ship wakes

In 2010, CMST undertook a comprehensive measurement program of boat wakes on the Swan River, Perth. A pressure sensor waverecorder was mounted to the seabed or a fixed pilon, and a full set of speeds and passing distances were analyzed for each vessel.

This project gave us valuable experience in measuring and analyzing boat wakes, wind waves and shoreline erosion parameters. Applications of this type of measurement include:

- Assessing effect of vessel type and speed on wake
- Comparing boat wakes with ambient wind wave climate

Measurements can be done for small vessels up to cargo ships, and ultrasonic sensors can also be used for real-time wave monitoring.

High-frequency accelerometers were used to study vortex shedding from stabilizer fins on Hanseatic Silver

Other flow measurements

CMST is experienced in undertaking full-scale trials to investigate a wide range of hydrodynamic effects. Other types of trials we have performed include:

- Using high-frequency accelerometers to study vortex shedding from stabilizer fins on a superyacht
- Diagnosing speed loss due to propeller ventilation on a crayfishing boat
- Diagnosing cavitation damage from the propeller shaft bracket on a passenger ferry

CMST has a Memorandum of Understanding with the Australian Maritime College and can assist with arranging model tests in the towing tank or model test basin.

Two-boat trialling using GPS and inertial measurement units at Fremantle Sailing Club

Sailing yachts and dinghies

CMST has a long history of sailing research, and several of our staff are avid sailors. Examples of our past sailing research include:

- 5 America's Cup campaigns
- Sydney 40 racing yacht development
- Hull modifications for Jon Sanders' non-stop triple circumnavigation
- SailTool sail analysis software development

Our waterfront facility at Fremantle Sailing Club houses most of our marine equipment, and we have a strong association with the club.

Sailing research that we are able to do includes:

- Using GPS / IMU to measure boat motions in 6 degrees of freedom
- Analyzing sail shapes using SailTool
- Developing computer models for hull hydrodynamics and sail aerodynamics

Founded in 1985, the Centre for Marine Science and Technology comprises a multi-skilled body of scientists and engineers committed to research and development. It conducts world-class consulting, research, technology development and education for industry and government agencies.

Three modes of operation are available:

- Commercial-in-confidence consulting, research and development
- Accessing state and federal government grant schemes
- Postgraduate student research

A wide range of clients have utilised the ship hydrodynamics services of CMST including: AECOM, AIMS, Australian Reef Pilots, BAE Systems, DSTO, Fremantle Ports, Fugro-TSM, Hanseatic, JFA Consultants, Marine Department Hong Kong, NZ Maritime Safety Authority, Swan River Trust, Tidewater Marine.

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