

VIRTUAL ARCHAEOLOGY UNRAVELS HISTORIC SHIPWRECK MYSTERY



Sydney-Kormoran Project 3D Reconstruction of the HMAS Sydney II High Altitude Control System (HACS). Image courtesy of Curtin University and WA Museum. © WA Museum.

During World War II, the Australian ship HMAS Sydney (II) encountered the German raider HSK Kormoran and after a short but fierce battle, both ships sank, taking with them all 645 crew from the Sydney and almost 100 crew from the Kormoran. The exact resting place of these wrecks was unknown until their discovery in 2008, when they were located 200km off the coast of Western Australia at a depth of 2.5km below the ocean's surface. These ships are very historically significant, but until now they have been inaccessible due to their isolated location. Using remotely operated vehicles (ROVs) fitted with digital still and video cameras and the power of the Pawsey Supercomputing Centre's Magnus supercomputer, a team of researchers from Curtin University are recreating the wreck sites in 3D to make this important piece of Australian history available to the general public.

PROJECT TEAM

DR ANDREW WOODS
DR ANDREW HUTCHISON
MR JOSHUA HOLLICK
CURTIN UNIVERSITY

SYSTEM

MAGNUS

TIME ALLOCATED

1,000,000 HOURS

AREA OF SCIENCE

3D IMAGING AND
3D RECONSTRUCTION

APPLICATIONS USED

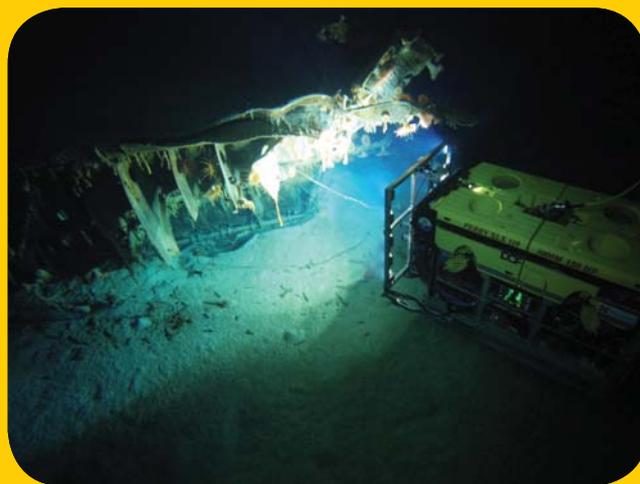
OpenCV (2.4.9+) - Library,
GCC - Compiler,
CMVS/PMVS2 - Software,
Multicore Bundle
Adjustment -
Library

3D RECONSTRUCTION PROCESSING FOR THE HMAS SYDNEY (II) AND HSK KORMORAN 3D IMAGING PROJECT

THE CHALLENGE

"The project has been huge and has involved a lot of people, a lot of partners, a lot of hard work, and a lot of technology," Dr Woods says. "Some of the project challenges were budget (how on earth were we going to complete such an ambitious project with a limited budget), logistical (reaching the two most isolated sites on the Australian Heritage Register), and technical (we had a huge amount of camera and lighting equipment to connect to two underwater vehicles, and it all had to work at considerable water depth)."

To access these remote wrecks, Dr Andrew Woods, Dr Andrew Hutchison, and Mr Joshua Hollick worked with the WA Museum to use two ROVs from offshore services company DOF Subsea fitted with new-to-market cameras capable of cataloguing such a large site and operating successfully at 2.5km underwater. The team collected half a million photographs and 300 hours of high definition video footage – in total some 50 terabytes worth of data. Using conventional methods, it would have taken 1000 years to process this vast amount of data. The team needed to find a way to reduce this time to something achievable.



Sydney Kormoran expedition 2015. DOF Subsea ROV inspecting Kormoran engine room. Image courtesy of Curtin University and WA Museum. © WA Museum.

THE SOLUTION

The researchers are utilising the computing power of Pawsey's Magnus supercomputer to feature-match the images and build their 3D models – using a complex process known as photogrammetric 3D reconstruction.

"The wreck sites are expansive and detailed, which causes a problem for conventional 3D reconstruction processing techniques. We are therefore developing custom software to run on Magnus to perform our 3D reconstruction processing," Dr Woods says.

The method being used by the team is a multi-stage process – after identifying common features between images, Magnus builds a cloud of points (representing the common features) in 3D space, over which a 3D mesh is fitted, and the original images are placed to form the final 3D model.

"Fortunately the 3D reconstruction process is highly parallel in nature and very suitable for running on Magnus which allows thousands of operations to be performed in parallel which speeds up the process considerably."

OUTCOME

The completed reconstructions could be available to the general public in two to three years and will form part of a new exhibition in several Western Australian Museum sites to commemorate the Sydney, the Kormoran, and their lost crew. The team could potentially also print 3D models of the ships

and related artefacts. The site is protected by the Historic Shipwrecks Act which prevents the removal of artefacts from the wreck sites, so 3D printed physical reproductions could be used in future exhibits in place of the real thing. Of the photogrammetric 3D reconstruction method they're

using, Dr Woods says, "The process could be applied to other underwater sites such as tropical coral reefs or oil and gas infrastructure and other shipwrecks, but the process could also be used in land-based environments such as complex rock-art fields, or underground mines."