# Using SWAN to monitor water quality in reservoirs

*New generation Smart Water Assessment Network has spatial and temporal water quality monitoring capabilities that can help to monitor reservoir water quality*



**Fig. 1:** NUSwan robots performing water quality profiling in Pandan Reservoir

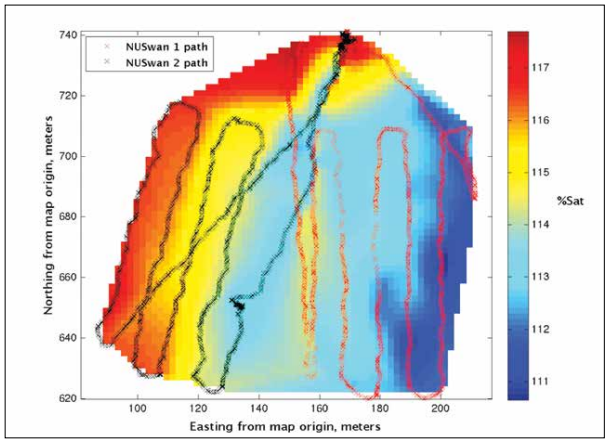




**Fig. 2:** spatial estimate of dissolved oxygen levels based on readings from NUSwans

Freshwater reservoirs are complex environments that are highly dynamic over time and space. The water quality of the reservoir can be affected by factors such as increasing urbanisation, recreation and other human activities in the catchments and reservoirs. At present, water quality monitoring is typically conducted using fixed online stations which provide limited coverage, by taking a boat to fixed locations to collect grab samples, or by taking manual in-situ measurements, which are tedious and time-consuming.

To address this challenge, a team at the National University of Singapore led by Teong Beng Koay is developing a smart robotic platform that allows both spatial and temporal monitoring of water quality in Singapore's freshwater reservoirs. Named NUSwan, the robot is designed to look like a white swan and traverse unmanned across the reservoir surface to perform water quality profiling at locations of interest (Fig. 1).

The NUSwan is designed to autonomously plan an energy-efficient route to the selected monitoring points. The system also minimises operation logistics by removing the need for a support vessel as the robot autonomously returns to a predefined shore-based service station for regular maintenance and charging. The data collected on-board the robot will be streamed in real-time to a command centre for efficient dissemination to the operators, and the sampling behaviours can be altered by the operators remotely based on the observed data.

A typical NUSwan operation would involve deploying multiple NUSwan robots to simultaneously and collaboratively sample an area of interest. This operational strategy makes it possible to detect gradients across a plume, allowing for a better appreciation of the distribution of nutrients in the area (Fig. 2). "We hope to generate new insights into our environment with the new interactive sampling capability and improved spatio-temporal sampling resolution," says Koay.

Besides operating as a stand-alone system, the NUSwan can also be deployed with other monitoring platforms. For example, when deployed together, NUSwan and underwater robots complement each other in their operations, providing enhanced profiling of both the reservoir surface and the entire reservoir depth for better understanding of the environment. The NUSwan can also be deployed together with fixed buoy monitoring systems to significantly expand the spatial coverage of monitoring.

The NUSwan currently carries standard, commercially available sensors for measuring parameters such as Chlorophyll-a, dissolved oxygen, turbidity, and blue-green algae, and can be extended to include new sensors. Combined with real data delivery, the NUSwan potentially serves a wide range of applications, such as water body surveillance, autonomous spot water sampling, and pollutant tracking, and has the potential to be integrated as part of early warning and decision support systems.

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