News Article for RISUD Strategic Focus Area (SFA) Scheme

		Name	Department
1.	**Principal Investigator**:	Xingjian Jing	ME
2.	**Name of SFA:**	Robotics for urban infrastructure	
3.	**Project Title:**	**Robotic Technology for Underwater Infrastructure Inspection**	

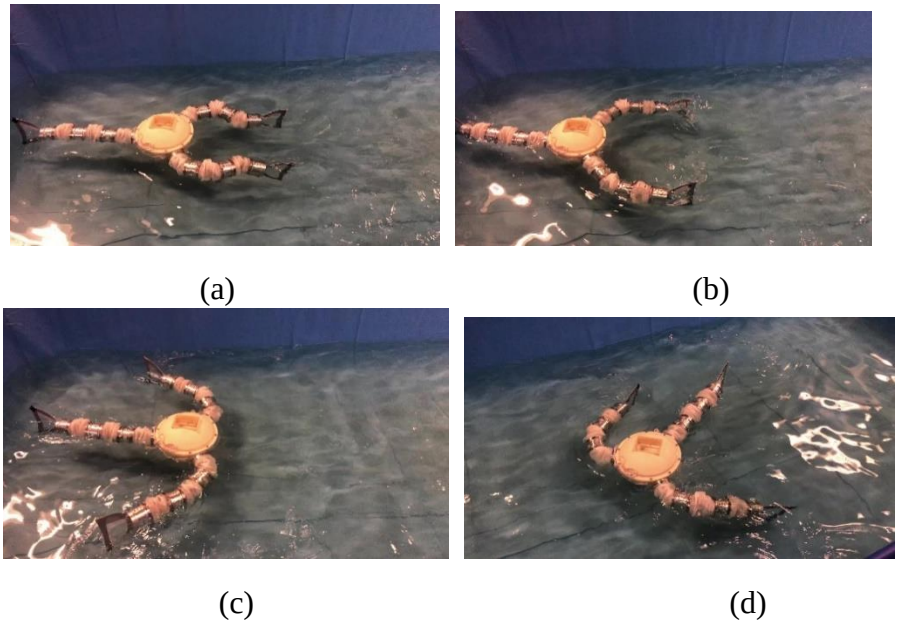
4. **Second Year Progress/Achievement**

Monitoring underwater environments is a challenging problem for several reasons. Being underwater for long periods of time is inherently dangerous for humans, and there are strong limitations on duration and depth of dives. Even if an underwater robot is used, the lack of high bandwidth wireless communications underwater makes it difficult to remotely operating a vehicle underwater. However, many examples can be easily seen, strongly requiring effective technologies for underwater tasks, including long distance deep drainage tunnel inspection in HK, underwater inspection and maintenance of business-critical infrastructures such as cables or piping systems, natural sources inspection, or coastline monitoring etc. A reliable and innovative solution is thus in a great demand, which has not been well explored in the literature.

This project is aimed to present a novel bio-inspired robotic system equipped with desired powerful functions for underwater infrastructure inspection. To this aim, various fundamental technical issues are addressed both in theory and methods. A novel robotic system is systematically developed with a new bio-inspired structure design to ensure sufficient mobility and stability in dynamic underwater environments.

After two-year investigation, several prototypes of a novel bio-inspired omni-directional swimming three-tail robot (BIODTTRot) are designed and tested in a swimming pool. It is shown that this BIODTTRot is a unique design of fish-like robots, of high mobility, high agility and high stability in water environment, which can achieve multiple motion modes mimicking different aquatic animals, including fast rotation without turning radius, Omini-directional movement in 3-D environment, Free switching among single-tail with two tails as steering, double-tail with one tail for steering, or triple tail propulsion modes, Diving or suspension in the water like an octopus or jellyfish and so on.

Fig 1. The 2-tail submersible under water robot of capability rotation motion in water without turning radius.



(a) (b)

(c) (d)

Fig 2. Free switching among single-tail with two tails as steering, double-tail with one tail for steering, or triple tail propulsion modes, indicating flexibility in motion control.

As a summary of the innovative features of this novel robot,

i) It is a new bio-inspired underwater robot with a three-tail design;
ii) It is able to achieve omnidirectional motion due to the three multi-DoF tails;
iii) It is able to mimic different aquatic species;
iv) High maneuverability and agility, compared to one-tail design;
v) Ability to move in different environments, including dry, water surface and underwater environments with organic solids or muddy water;
vi) It is a new energy-saving design, compared to classical-propelled underwater robots.

All the above motion capabilities of the BIODTTRot are critically helpful for the robot to conduct underwater infrastructure inspection in dynamic and complex underwater environments.