Maritime State University named after Admiral G.I.Nevelskoy. Vladivostok, Russia.

Technical Design Report of MSU AUV team.

1. Abstract

This paper is about our way of thinking between last year and this year competitions.It shows what we were trying to accomplish to improve our performance, what methods we used and how we got prepared for this year Robosub18 Competition.

2. Competition strategy

Having studied last year results, we decided, that the best way to improve performance on competition would be using more than one vehicle. Parallel performing by two AUVs allows accomplishing twice as much tasks in the same time. This year we use two vehicles with a payload distributing regarding specific routes of the AUVs. Our main robot is modified version of AUV we used last year. We equipped it with two cameras for computer vision and three hydrophones so it could find location of acoustic pingers. This vehicle will perform tasks in areas marked by pingers such as Roulette and Cash In so it has marker-dropping device (markers for the golf balls). Our second vehicle (or mini AUV) has two cameras for computer vision as well. Its goals are moving along the orange road, Play Craps and Buy a Gold Chip (though we do not intend to drop it) so mini AUV has also golf catcher for the golden chips. We do not use manipulator because its implication in AUV system we consider too complicate and unreliable (yet). Besides, on the moment I write this article we are not yet sure if we are going to use our torpedo cannon because it is heavy and can interfere with mini AUV systems. Anyway we think that time we save for performing tasks in all areas of the course with two vehicles will allow us to get maximum of scores.

3. Design Creativity

Our main upgrade this year is changing of the thrusters on the main vehicle. Last year we used custom thrusters, but our production technology was undeveloped so we ended up with unreliable thrusters and had to reduce their power to 30% of nominal power of motors and our vehicle was probably the slowest robot in the world. Considering this, we decided to buy a set of thrusters, but it had external control system. We developed addition aluminum housing and a small custom PCB with STM32F407 microcontroller as thrusters control unit.

4. Experimental Results

We only use in-water tests because we believe we do not possess production technology accurate enough to use estimated data in simulation. Our philosophy is to calculate approximately what we devices we could use in competition. Next stage is to construct or develop such devices and compensate difference between estimated and what we have. When it is done, we test it underwater on the AUV. We try to spend about five hours per day when we have spare time in the swimming pool last month before competition. About two week prior the flight, we stop any developing and focus on maintaining reliability.

5. Acknowledgements

We thank our University, including its production department for providing us with opportunity to participate Robosub18 and providing us with workshop and tools so we could

unleash our creativity. We also want to thank Center for Robotics Development, originally part of our united team. Unfortunately, due to financial problems, they were unable to send people to the site, but they provide us with our mini AUV so we should be stronger than ever.

6. References

[1] http://www.robonation.org/node/433 – The results of Robosub2017.

[2] http://murproject.com/ - MurProject – base of our miniAUV.

Appendix A: component specification

Component	Vendor	Model/Type	Specs
Buoyancy Control	Custom		extruded polystyrene foam
Frame	Custom		Polyethylene
Waterproof Housing	Custom		Aluminum
Waterproof Connectors	Custom		pneumatic pipes
Thrusters	Center for Robotics Development	RovBuilderProjects	2 kgf
Motor Control	Custom	STM32F407	
High Level Control	Intel	NUC	
Actuators	Center for Robotics Development		
Propellers	Center for Robotics Development		
Battery			24V LIPO
Converter			
Regulator			
CPU	Intel	NUC/Edison	
Internal Comm Network			Ethernet
External Comm Network			Wi-FI
Programming Language 1			C++
Programming Language 2			Chai Script
Compass			ADIS 16480
IMU			ADIS 16480
DVL			
Camera		Front and Bottom	fullHD
Hydrophones	Custom		
Manipulator			
Algorithm: vision			YOLO DNN
Algorithm: acoustics			TDOA est. & triangulation
Algorithm: mapping			
Algorithm: autonomy			Chai Script
Open source software			QT
Team size			5 on site, 12 participated
HS/SW expertize ratio			0,6
testing time: simulation			10 hours
testing time: in-water			100 hours

Appendix B: Outreach Activities.

Two team members of our site crew (Esin and Gorelov) are mentors for underwater ROV student team of MSU named after Admiral Nevelskoy participating in international ROV MATE competition. In 2018 the competition took place in Federal Way, WA. We also work for Center for Robotics Development as teachers for robotics classes for children. The educational program based on Lego Mindstorms kits.