

## Reports of 7th underwater robot festival in Kitakyushu

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### Abstract

For enhancement of oceanic engineering technology and researchers, underwater robot competition has been held since 2016. Seventh competition in this year consists AUV league that university's vehicles automatically cruise at field and junior league that underwater craft is made. The paper reports competition regulations of AUV and junior league and results of the competition held in October 2019.

*Keywords:* Robot competition, Autonomous underwater vehicle, junior league

### 1. Introduction

To advance field robotics technology, the center for socio-robotic synthesis of Kyushu institute of technology organizes a several competitions every year<sup>[1-2]</sup>. We held 7th underwater robot festival that consists of AUV and junior leagues for providing a place to present research results, at Kitakyushu in October 2019. The AUV league is the competition that autonomous underwater vehicles (AUVs) developed by research institutes automatically navigate at field and perform tasks by using mounted sensors and camera. High school students and below can join the junior league and take the lectures on mechanical

design, electrical circuits and programing required to make unmanned surface vehicle (USV). After the lectures, the students join the game that check the performance of handmade USV.

The paper explains the regulations of the AUV and junior leagues and reports he competition that was held at Aso sports center in Kitakyushu from October 19 to 20.

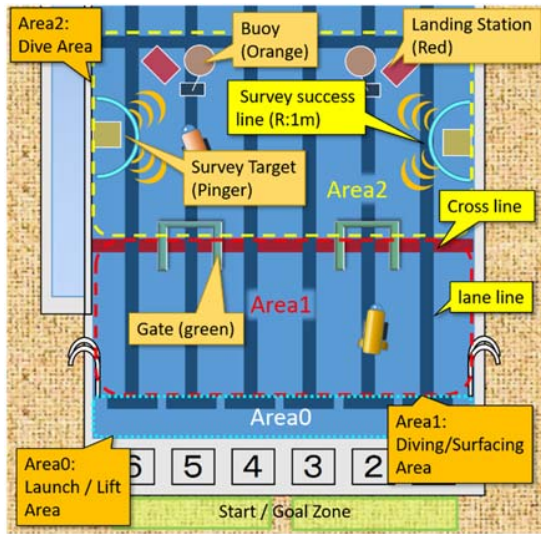


Fig.1 Game field for AUV league

## 2. Outline of the competition

### 2.1. Committee member

Committee member of the competition consists around professors that belong the university near Kitakyushu. Executive chairman is prof. Nishida belonging Kyushu institute technology of host university, prof. Sato of Nagasaki Institute of Applied Science and prof. Sonoda of Nishinippon Institute of Technology take AUV league, prof. Takemura of Nishinippon Institute of Technology and prof. Matsuo of National Institute of Technology take junior league, and prof. Yasukawa of Kyushu Institute of Technology is home page designer for the competition. Other committee member supports two league and invited participant to the competition.

### 2.2. AUV league regulation

Participants use developed AUV for the game of the AUV league, the game is judged on three items that are presentation (total 40 points), wet test (total 430 points) and deployment technology (total 30 points) inspections. In presentation inspection, university professors evaluate participants presentation with structure, speaking, explicitness, technology, answering and presentation time. Wet test inspection is done at the field shown Fig.1, and each team has five minutes for preparing the AUV and ten minutes for six underwater tasks that are Gate Pass to through the gate (max. 20 points), Buoy Touch to attack colored ball (max. 80 points), Investigation

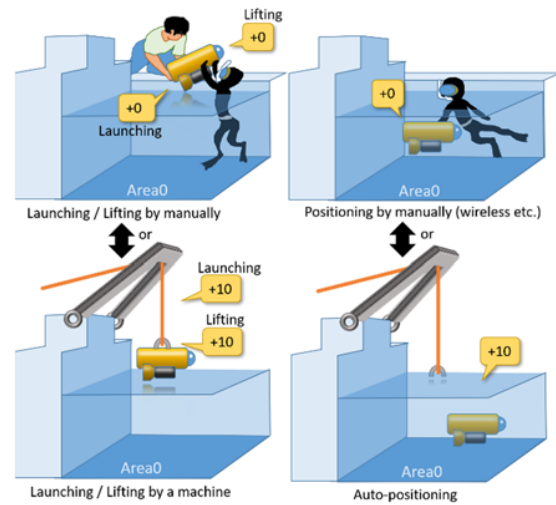


Fig.2 Deployment technology inspection

Mission to search and touch the pinger which nobody know its position (max. 200 points), Landing Mission to put on the bottom table (max. 100 points), Returning Mission to return back to start point (max. 10 points) and Drop Mission to drop marker on the landing table (max. 20 points). Wet test regulation decided with reference the regulation of other international underwater competition, and the Investigation Mission assuming actual survey by the AUV was introduced to the competition since last year. The deployment technology inspection evaluates deployment method which is the most important for actual AUV survey. When the AUV is put in the water by using developed deploy device without diver supports as shown in Fig.2, the team gets points which depend on its deployment technology. Even if the AUV deployment is succeeded, if the game field is corrupted or its deployment method is a danger, the score of its team deducted.

### 2.3. Junior league regulation

The purpose of the junior league is that participants acquires the minimum knowledges required for development of underwater vehicle, and they take the lectures on mechanism, electrical circuit and programing. The committee provides all teaching aids and tools for the lectures, and university professors teach carefully from the basics. Therefore, every high school student and below can join the league and make the robot. Surface vehicle shown in Fig.3 was selected as a teaching aid assuming that participants that can play it at home. The



Fig.3 Surface vehicle made in the junior league



Fig.5 AUVs that cruise in the competition field



Fig.4 Presentation inspection in the AUV league

vehicle has two thrusters for heading and surge controls and a microcomputer with wireless module for controlling the thrusters by remote control. After the lectures, participants play the game that the surface vehicle navigates to the goal avoiding obstacles. The shape and program of the surface vehicle can be freely modified by participants.

### 3. Competition results

#### 3.1. Competition participants

Six university teams for the AUV league, 14 teams for the junior league and 40 people for tour joined the competition. 15 staff members in addition to the committee member managed the competition, 130 people that is largest in last few years came to the competition venue. Because the expensive AUV must be developed for participate to the AUV league, only the same university team joined the AUV league every year. However, this year new teams such as Hiroshima Institute of Technology and Osaka Prefecture University

were more than usual. The participating schools in the junior league was the same as usual, but many teams entered the league.

#### 3.2. AUV league results

Each team played a round robin tournament in last year with a few participant teams, but qualifying was separated two leagues and the final tournament was round robin tournament that consist of top four teams in this year with six participant teams. Methods for the tasks of wet test inspection has been diversifying with improvement of underwater robot technology, each team explained original AUV technology and wet test strategy as shown in Fig.4 in wet test inspection. Because only students developed their AUV without researchers and professors, The AUVs of participant teams often got stuck by various problems every year. However, in this year, the AUVs of all teams cruised in the competition field as shown in Fig.5, and each team competed fiercely. As a result of all inspections, the team of Hiroshima Institute of technology was the champion in the AUV league, the second place was the team of Kyushu Polytechnic College and third place was the teams of the university of Tokyo and Tokyo Institute of Technology.

#### 3.3. Junior league results

Almost participant students in junior league was not used to robot making, and there were problems that such as electronic component failure, thruster failure and surface vehicle damage. However, all teams enjoyed making the surface vehicle and was able to complete the vehicle through good offices of the professors and the assistant staffs, as shown in Fig.6. Because the professors



Fig.6 The participants in the junior league during the lectures



Fig.7 Their vehicle adjustment by the participants

explained waterproof structure principle and operational notes of the surface vehicle in the lectures, the vehicles of all teams can cruise on the surface without water leakage. After the lectures, the students actively participated in the game using the vehicle and adjusted their vehicles each in their own way as shown in Fig.7. As results of the game held on the last day, the team of National Institute of Technology, Kitakyushu College was the champion in the junior league and the teams of Jyoto High School were the second and third place.

#### 4. Conclusions

We had a very hard time arranging a venue where the competition could be held even in rainy weather, but the underwater robot festival could be held with safety by the generous cooperation of Kitakyushu City and the facility staff. By actively support of committee members and assistant staffs, we smoothly organized the competition, and all participants of the AUV and junior league enjoyed played the game. We were able to gather many participants through the good offices of the committee members, but there were few general participants who observe the competition. In order to gather more the general participants from next year, glamorous events will be added in the competition.

#### Acknowledgements

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Fig.8 Group photo of everyone participated in the competition

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