Technical Design Report Instructions

RoboSub 2021 (Online) *www.robosub.org*

Paper Preparation Overview:

Each team is required to submit a TDR that describes the design of their vehicle, as well as strategies for their approach to the tasks. The TDR should also include rationale for design choices. Teams must follow the TDR instructions provided on the RoboSub website.

Format:

The format of the written paper shall adhere to the following guidelines:

- **10 page limit (excluding References and Appendices)**
- 8.5 x 11 in. page size
- Margins ≥ 0.8 in.
- Font: Times New Roman 12pt
- Header on every page including team name and page number
- Submitted in pdf format

Access all past competitor's papers on the Past Teams' page, **robosub.org/past-programs.** (Click on the year you'd like to view and scroll down to the team section.)

Paper Contents:

The written paper consists of six mandatory Sections and one mandatory Appendix. Additional sections may be included; however, the overall limit of 10 pages applies (excluding References and Appendices). In general, the editorial style for IEEE Conference Proceedings should be followed: www.ieee.org/conferences/publishing/templates.html. The two-column format is optional. We recommend that papers be peer-reviewed prior to submission. You can utilize resources at your institution, teams entering other RoboNation competitions, or on the community forum for this peer-review. Professional editing services are also available: secure.aje.com/en/default/submitb/select.

1. Abstract

The abstract is a short summary of the main points in the paper. The paper should primarily describe the linkage between your overall competition strategy and your system architecture, design and engineering decisions.

2. Competition Strategy

This section should discuss how the team plans on approaching the course and how the vehicle design relates to this approach. The course consists of multiple tasks with associated points for accomplishment. The only required task is passing through the start gate. Other tasks are optional and can be attempted in any order. The more tasks a vehicle is designed and engineered to accomplish, the more complex the overall vehicle system will be. The discussion should include the team's consideration of the trade-offs between system complexity and reliability. For example, teams have a limited number of working hours to prepare for the competition; this time could be spent adding additional capabilities or testing and improving the reliability of an existing capability. As system complexity grows, changes in subsystems can propagate in unmanageable ways when time is limited. Clearly, the goal of a competition is to score more points than the other teams. There are many ways to do this. Studying past competitions may be instructive. Based on history and the system engineering talents of your current team, describe your strategic vision.

3. Design Creativity

Given your strategy for winning and your approach to managing complexity, describe the creative aspects of your system. Novelty may occur at component, subsystem, and/or integrated system levels. Describe your experience in making both architectural/design decisions and system engineering decisions. This section should **not** include detailed component descriptions and/or specifications not of original design. The latter should be described in Appendix A.

4. Experimental Results

This section should describe various tests planned and/or accomplished to date, both in-water and in simulation. There is a strong correlation between in-water testing time and competitive performance in the arena. Given unique challenges leading up to this year's competition like the global Covid-19 pandemic in addition to typical student time constraints, balancing creative design and system engineering with testing and experimentation can be a challenge. How did your team estimate the amount of testing required to meet your reliability goals? How did/sill you balance the demands of design and engineering with those of testing and experimentation?

5. Acknowledgements

Participating in the competition, as in all research projects, involves marshalling resources and support beyond the efforts of individual team members. This support can take many forms, such as technical advice, labor, equipment, facilities, and monetary contributions. Acknowledging those who have underwritten your efforts is important.

6. References

As with any technical publication, original ideas and content not generated by the paper's authors should be properly cited. While there are many citation styles, the IEEE Conference Proceedings style should be used, found on the following link: www.ieee.org/conferences/publishing/templates.html.

Appendix A: Component Specifications

In the past, detailed descriptions of components constituted the bulk of many written paper submissions. Such detail often distracts from understanding the team's underlying strategic thinking, design and engineering decisions, or novel contributions. Teams should list and indicate the "status" of components selected/purchased/installed for the vehicle in the table below. Where components were developed by the team versus purchased off the shelf, this information should be included. Also, if commercial off the shelf equipment was significantly modified this should be noted. This standardized table will help document and track trends in component (hardware and software) usage and team metrics. Under the column marked "Specs" you may provide a web link to the manufacturer's specifications. The form below is generic and you should report all components you have included in your vehicle design.

Component	Vendor	Model/Type	Specs	Cost (if new)	Status
Buoyancy Control					
Frame					
Waterproof Housing					
Waterproof Connectors					
Thrusters					
Motor Control					
High Level Control					
Actuators					
Propellers					
Battery					
Converter					
Regulator					
CPU					
Internal Comm Network					
External Comm Interface					
Compass					
Inertial Measurement Unit (IMU)					
Doppler Velocity Log (DVL)					
Vision					
Acoustics					
Mainpulator					
Algorithms: vision					
Algorithms: acoustics					
Algorithms: localization and mapping					
Algorithms: autonomy					
Open source software					
Team Size (number of people)					
Expertise ratio (hardware vs. software)					
Testing time: simulation					
Testing time: in-water					
Inter-vehicle communication					
Programming Language(s)					

Appendix B: Outreach Activities (optional)

A foundational purpose of RoboSub has been to strengthen and enhance the community. Teams are encouraged to participate in educational outreach activities and describe those activities here. The judging score includes points for educational outreach on all levels.