Soekarno Aterkia-03 Autonomous Based Ship

4.0 Innovation

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***Abstract*—Diponegoro University Robotic Development Center, Roboboat Team, is ready to look for a new innovation coming in this 4.0 generation where everything is based on autonomous needs. The vehicle that Aterkia is bringing to 2018 AUVSI Roboboat Competition is an autonomous ship designed effectively for energy usage. Not only that, it also provides a drone coorperation which I also a new step to take the game to another level.**

Keywords—arduino mega, arduino nano, apm 2.8 (drone), raspberry pi 3, esc seaking 90A, motor brushless, logitech c310, ultrasonic

I. INTRODUCTION

Roboboat Universitas Diponegoro is a place to apply research and development in the robotic field based on the improvement of maritime technology globally with amassing potential collages in Universitas Diponegoro.

Roboboat UNDIP Team is divided into 3 divions with total of 25 members (16 eligible members, volunteers, alumnies and 2 lectures) Mainly mechanical, electrical, and official. The mechanical division mostly handle designing, production, and engines installations which will be used in competitions, such as: design and analysis, ship production, propultion, and machinery. The electrical division is responsible for programming and autonomous system appliance used in the competition. Namely: Image processing, automation, hardware, telemetry and software engine. The last one is the official division, it handles the needs related to human resources and outside links such as: website making, public relation, media creative, project manager, and sponsorship. ATERKIA is a ship designed by Roboboat UNDIP Team. This ship uses autonomous system to enroll in Roboboat Technology Competition held by AUVSI and also KKCTBN which is a competition for Fast Autonomous Boat held by Kemenristekdikti. Achievements obtained by our team before are:

- 6th place and Best Design of Cost Performance in 4th International Roboboat Competition 2011.
- Hull Form Design Award 5th International Roboboat Competition (AUVSI) 2012

II. COMPETITION STRATEGY

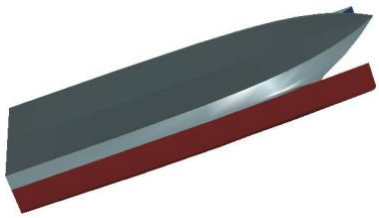
Making a clear timeline is one of the first steps taken by Aterkia Diponegoro team. The first is to study the roboboat rule. The team tried to understand every mission in the rule, then understood the ship's specification requirements and drones. The second is to start designing ships and drones that will be used to conquer every mission. Not only the hardware components designed, but algorithms candidate which are generally designed. Third, the work of shipbuilding and drones. Components that have been designed starting to be assembled, ranging from mechanics, sensor placement, actuators, switches, to wiring. The design of the algorithm has also begun to be implemented to the coding. Fourth, testing and trial. Trial is done to perfect the algorithm so that the ship & drone able to run efficiently and run in various conditions during the race.

III. DESIGN CREATIVITY

For its architectural design, it adopts from a Cruise Ship type boat with some modifications such as the foundation for drones. In its engineering system, the ship is designed using two motors for propulsion with no rudder. What distinguishes this ship with other ships is its hull form, which when viewed from above has a wide deck and fused like a monohull ship while its hull form is a catamaran hull form. We chose this design with several considerations, including consideration of the stability of the ship, the extent of deck to put the components, as well as consideration of better speed.

Aterkia-03 uses hull with catamaran type. This is the third type of hull used in this research. The catamaran hull selection consideration is that the hull has sufficient width so there is plenty of room for the component and has better stability than the monohull. The design was inspired from the USNS millinocket (T-EPF-3) vessel which is a logistics ship for the benefit of US Army and USMC. This ship can travel speeds up to 40 knots. This proves that the catamaran boat design has a good ability in stability and capable of spurring a relatively high speed

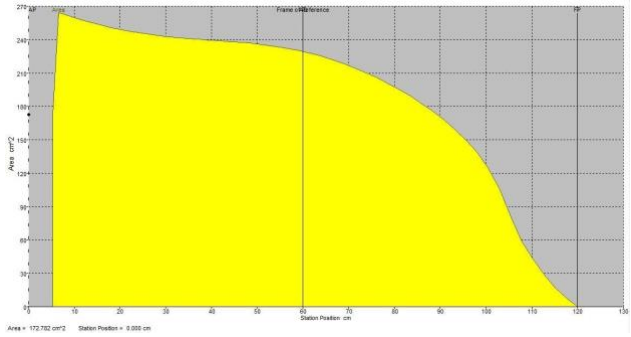
Aterkia-03's design philosophy itself is a blend of balance and speed in which the ship is designed to meet the needs of adequate space, has sufficient stability and can go with the desired speed.



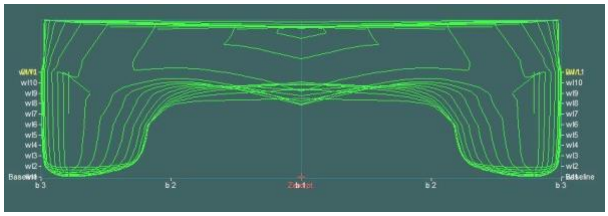
Name	Aterkia-03	
Type	Catamaran	
Length	125	cm
Beam	50	cm
Height	15	cm
Draft	10	cm
cb	0.368	

displacement	22.6	kg
vs	15	kn

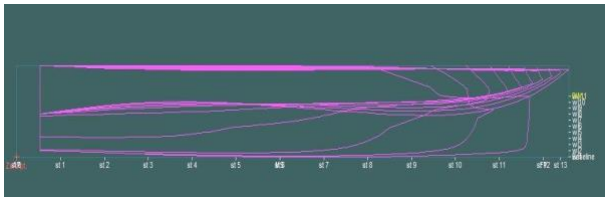
A. Curve Section Area



B. Body Plan



C. Sheer Plan



D. Ship's Characteristic

Displacement	22.6	kg
Volume (displaced)	22049.02	cm^3
Draft Amidships	10	cm
Immersed depth	10	cm
WL Length	125	cm
Beam max extents on WL	50	cm
Wetted Area	8690.32	cm^2
Max sect. area	265.69	cm^2
Waterpl. Area	5045.27	cm^2
Prismatic coeff. (Cp)	0.692	
Block coeff. (Cb)	0.368	
Max Sect. area coeff. (Cm)	0.598	
Waterpl. area coeff. (Cwp)	0.842	
LCB length	51.67	from zero pt. (+ve fwd) cm
LCF length	56.37	from zero pt. (+ve fwd) cm
LCB %	43.06	from zero pt. (+ve fwd) % Lbp
LCF %	46.973	from zero pt. (+ve fwd) % Lbp
KB	6.38	cm
KG fluid	0	cm
BMt	44.47	cm
BML	201.9	cm
GMt corrected	50.85	cm
GML	208.28	cm
KMt	50.85	cm
KML	208.28	cm
Immersion (TPc)	5.171	tonne/cm
MTc	0.392	tonne.m
RM at 1deg = GMt.Disp.sin(1)	20056.45	kg.cm
Length:Beam ratio	2.404	
Beam:Draft ratio	4.992	
Length:Vol^0.333 ratio	4.279	
Precision	Medium	66 stations

IV. Experimental Results

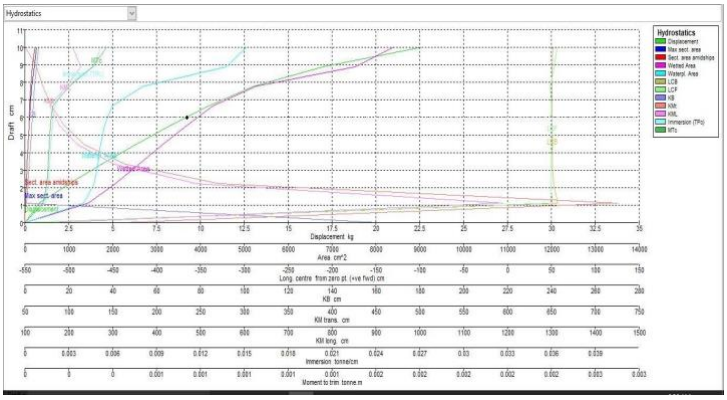
Since the team members are students, the usual water trials are conducted every empty hour between classes and holidays. For simulation, the team used a simulation when designing ship mechanics. We rarely use simulations for image processing purposes because of the limited team's software.

In order to reach the target, we do more trials in the water. When there is a deadlock (the ship can not work properly) in the water trial, we will research some methods from various reference sources. By researching from some of the reference sources we found we could find a solution to solve the problem.

A. Hydrostatic Curve

Define abbreviations and acronyms the first time they are used in the text, even after they have been defined in the

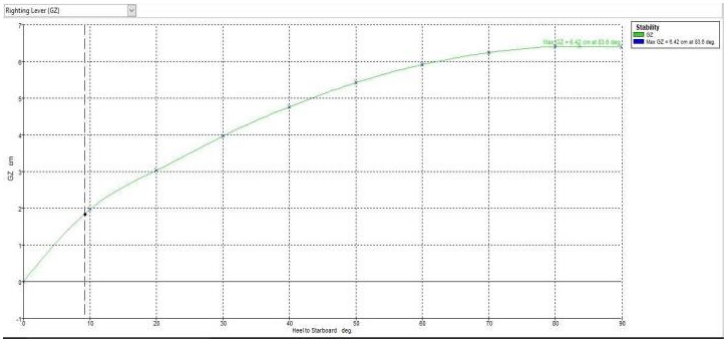
abstract. Abbreviations such as IEEE, SI, MKS, CGS, sc, dc, and rms do not have to be defined. Do not use abbreviations in the title or heads unless they are unavoidable.



B. Hydrostatic Result

	Draft Amidships cm	0.00	1.11	2.22	3.33	4.44	5.56	6.67	7.78	8.89	10.00
1	Displacement kg	0.0000	0.8251	2.524	4.373	6.300	8.304	10.47	13.05	17.00	22.60
2	Heel deg	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	Draft at FP cm	0.00	1.11	2.22	3.33	4.44	5.56	6.67	7.78	8.89	10.00
4	Draft at AP cm	0.00	1.11	2.22	3.33	4.44	5.56	6.67	7.78	8.89	10.00
5	Draft at LCF cm	0.00	1.11	2.22	3.33	4.44	5.56	6.67	7.78	8.89	10.00
6	Trim (+ve by stern) cm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	WL Length cm	0.00	113.62	114.49	114.57	114.62	114.64	114.66	114.67	114.68	114.69
8	Beam max extents on	0.00	49.21	49.56	49.70	49.78	49.83	49.86	49.89	49.91	49.92
9	Wetted Area cm^2	0.00	1439.84	2057.51	2598.86	3135.04	3692.97	4284.48	5259.28	7527.48	8395.21
10	Waterpl. Area cm^2	0.00	1335.93	1577.30	1662.43	1719.07	1822.55	1991.78	2696.62	4596.11	5045.27
11	Prismatic coeff. (Cp)	0.000	0.567	0.683	0.713	0.725	0.732	0.737	0.712	0.686	0.724
12	Block coeff. (Cb)	0.000	0.386	0.516	0.569	0.598	0.596	0.554	0.289	0.326	0.385
13	Max Sect. area coeff. (		0.741	0.817	0.851	0.871	0.854	0.817	0.467	0.542	0.598
14	Waterpl. area coeff. (C	0.000	0.711	0.734	0.739	0.744	0.744	0.721	0.475	0.804	0.881
15	LCB from zero pt. (+ve	-549.40	57.13	52.35	51.38	51.05	50.90	50.77	50.46	50.51	51.67
16	LCF from zero pt. (+ve	-549.40	50.83	49.96	50.18	50.40	50.36	50.17	48.62	53.14	56.37
17	KB cm	160.93	0.73	1.37	1.97	2.56	3.15	3.76	4.45	5.36	6.38
18	KG cm	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00
19	BMt cm	0.00	725.00	270.56	162.64	115.79	91.20	76.17	65.99	57.66	44.47
20	BML cm	0.00	1190.19	490.06	301.09	217.43	175.10	153.06	191.15	221.93	201.90
21	GMt cm	150.93	715.73	261.93	154.61	108.35	84.35	69.93	60.44	53.02	40.85
22	GML cm	150.93	1180.91	481.43	293.06	209.99	168.25	146.82	185.60	217.29	198.28
23	KMt cm	160.93	725.73	271.93	164.61	118.35	94.35	79.93	70.44	63.02	50.85
24	KML cm	160.93	1190.91	491.43	303.06	219.99	178.25	156.82	195.60	227.29	208.28
25	Immersion (TPc) tonne/	0.000	0.001	0.002	0.002	0.002	0.002	0.002	0.003	0.005	0.005
26	MTc tonne.m	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
27	RM at 1deg = GMt.Disp.	0.00	10.31	11.54	11.80	11.91	12.22	12.78	13.77	15.73	16.11
28	Max deck inclination de	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
29	Trim angle (+ve by ster	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

C. Stability Graphic



D. Stability Result

	Heel to Starboard deg	0.0	10.0	20.0	30.0	40.0	50.0	60.0	70.0	80.0	90.0
1	GZ cm	0.00	1.97	3.03	3.96	4.77	5.42	5.92	6.24	6.41	6.39
2	Area under GZ curve from zero heel cm.deg	0.000	10.426	35.906	70.866	114.657	165.728	222.576	283.514	346.921	411.008
3	Displacement kg	44.63	44.63	44.63	44.63	44.64	44.63	44.64	44.63	44.63	44.63
4	Draft at FP cm	14.19	16.18	19.53	23.68	29.04	36.50	48.25	70.86	137.32	n/a
5	Draft at AP cm	14.19	16.18	19.53	23.68	29.04	36.50	48.25	70.86	137.32	n/a
6	WL Length cm	120.27	111.98	106.05	102.03	107.71	114.69	114.69	114.69	112.63	104.00
7	Beam max extents on WL cm	49.35	24.03	23.21	21.97	20.33	18.49	16.69	15.37	14.61	14.88
8	Wetted Area cm^2	9745.14	13166.8	13500.0	13617.5	13657.6	13648.0	13600.1	13497.6	13385.8	13340.0
9	Waterpl. Area cm^2	5012.25	1524.77	1142.39	999.46	942.76	947.51	1010.28	1152.61	1320.85	1392.75
10	Prismatic coeff. (Cp)	0.766	0.804	0.846	0.879	0.832	0.781	0.781	0.780	0.794	0.858
11	Block coeff. (Cb)	0.517	1.073	1.204	1.195	1.042	0.870	0.753	0.623	0.553	0.588
12	LCB from zero pt. (+ve fwd) cm	54.78	54.70	54.74	54.76	54.78	54.79	54.80	54.82	54.84	54.80
13	LCF from zero pt. (+ve fwd) cm	57.32	52.96	51.91	51.50	51.40	51.51	51.58	51.36	51.83	53.86
14	Max deck inclination deg	0.0000	10.0000	20.0000	30.0000	40.0000	50.0000	60.0000	70.0000	80.0000	90.0000
15	Trim angle (+ve by stern) deg	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-1.#IND

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Team's members:

1. Team's leader: Bonar wahyu Hidayat
2. Vice leader : Muhamad hafiz tsalavin
3. Secretary: Ovin Ranica
4. Treasurer: Aulia Faradilla
5. Officials
   Head of division: Slamet Haryo Samudra
   - Members : Oka Wicaksana (Media)
     Amanda Margareth
     (Communication)
6. Mechanical
   Head of division: Ebin Ezer Sinaga
   - Members: Aji Farid Rohman hakim(analysis & design)
     Pujiyanto(production)
     Febby Ari saputro (production)
     Muhamad Fiqran(production)
     Radon Panji (volunteers)
     Ridwan Yurnal (volunteers)
7. Electrical
   Head of division: Alfin Luqmanul Hakim
   - Members: Ahmad Zaid(Telemetry)
     Muhamad Aghassi(Drone)
     Ibrahim(automation)
     Dimas Arfiantino (Hardware)
     Akhmad Naffiuddin
     (volunteers)

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