Soekarno Aterkia-04 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:

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 Threemaran . This is the third type of hull used in this research. Threemaran 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

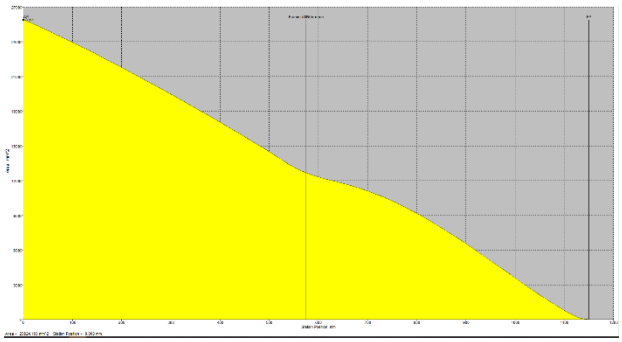
Aterkia-03's design philosophy itself is a blend of balance and speed in which the ship is designed to meet the

needs of adequate space, has sufficient stability and can go with the desired speed.

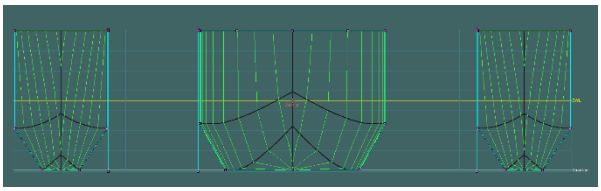
Name	Aterkia-03	
Type	Three maran	
Length	1150	cm
Beam	50	cm
Height	15.0	cm
Draft	10	cm
cb	0.443	

displacement	15.3	kg
vs	15	kn

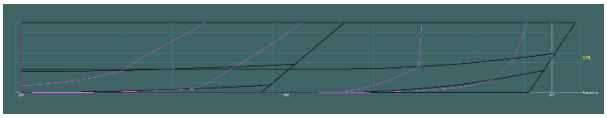
Curve Section Area



Body Plan



Sheer Plan



1. *Ship's Characteristic*

Displacement	15.3	kg
Volume (displaced)	15295725.2	mm^3
Draft Amidships	75	mm
Immersed depth	75	mm
WL Length	1150	mm
Beam max extents on WL	600	mm
Wetted Area	526082.2	mm^2
Max sect. area	25925	mm^2
Waterpl. Area	240186	mm^2
Prismatic coeff. (Cp)	0.513	
Block coeff. (Cb)	0.443	
Max Sect. area coeff. (Cm)	0.864	
Waterpl. area coeff. (Cwp)	0.522	
LCB length	389.9	from zero pt. (+ve fwd) mm
LCF length	395.8	from zero pt. (+ve fwd) mm
LCB %	33.905	from zero pt. (+ve fwd) % Lwl
LCF %	34.419	from zero pt. (+ve fwd) % Lwl
KB	40.8	mm
KG fluid	75	mm
BMt	292.2	mm
BML	1232.9	mm
GMt corrected	258	mm
GML	1198.7	mm
KMt	333	mm
KML	1273.7	mm
Immersion (TPc)	0.002	tonne/cm
MTc	0	tonne.m
RM at 1deg = GMt.Disp.sin(1	68.9	kg.mm
Length:Beam ratio	2.875	
Beam:Draft ratio	5.333	
Length:Vol^0.333 ratio	4.633	
Precision	Medium	59 stations

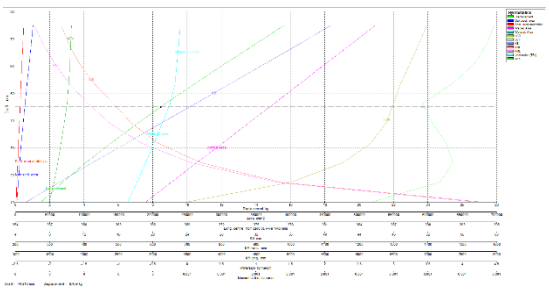
IV. Experimental Results

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



B. Hydrostatic Result

	Draft Amidships mm	10.0	17.2	24.4	31.7	38.9	46.1	53.3	60.6	67.8	75.0
1	Displacement kg	1.490	2.753	4.112	5.563	7.102	8.728	10.43	12.16	13.91	15.68
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 mm	10.0	17.2	24.4	31.7	38.9	46.1	53.3	60.6	67.8	75.0
4	Draft at AP mm	10.0	17.2	24.4	31.7	38.9	46.1	53.3	60.6	67.8	75.0
5	Draft at LCF mm	10.0	17.2	24.4	31.7	38.9	46.1	53.3	60.6	67.8	75.0
6	Trim (+ve by stern) mm	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	WL Length mm	1106.7	1111.5	1116.3	1121.1	1125.9	1130.7	1135.6	1140.4	1145.2	1150.0
8	Beam max extents on	553.3	563.0	572.6	582.2	591.9	600.0	600.0	600.0	600.0	600.0
9	Wetted Area mm^2	189710.	226901.	264139.	301555.	338578.	376278.	413605.	450505.	487423.	524384.
10	Waterpl. Area mm^2	163225.	177316.	189866.	201916.	213826.	225510.	232209.	235125.	237739.	240186.
11	Prismatic coeff. (Cp)	0.539	0.545	0.542	0.537	0.531	0.524	0.519	0.516	0.514	0.513
12	Block coeff. (Cb)	0.500	0.484	0.464	0.444	0.426	0.413	0.420	0.429	0.437	0.443
13	Max Sect. area coeff. (	0.928	0.888	0.855	0.827	0.803	0.788	0.809	0.832	0.850	0.864
14	Waterpl. area coeff. (C	0.562	0.550	0.536	0.523	0.511	0.504	0.511	0.515	0.519	0.522
15	LCB from zero pt. (+ve	368.9	378.0	382.6	385.0	386.3	387.0	387.6	388.4	389.2	389.9
16	LCF from zero pt. (+ve	385.1	391.0	392.2	391.6	390.4	389.5	392.1	394.0	395.1	395.8
17	KB mm	5.3	9.1	13.0	16.9	20.9	24.9	29.0	33.0	36.9	40.8
18	KG mm	75.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0
19	BMt mm	1554.1	964.7	726.5	598.4	517.8	460.7	401.6	355.1	319.9	292.2
20	BML mm	7696.1	4800.0	3538.2	2819.8	2357.5	2032.5	1764.1	1545.8	1372.9	1232.9
21	GMt mm	1484.4	898.8	664.5	540.3	463.8	410.6	355.6	313.1	281.8	258.0
22	GML mm	7626.4	4734.1	3476.2	2761.7	2303.4	1982.4	1718.1	1503.8	1334.8	1198.7
23	KMt mm	1559.4	973.8	739.5	615.3	538.8	485.6	430.6	388.1	356.8	333.0
24	KML mm	7701.4	4809.1	3551.2	2836.7	2378.4	2057.4	1793.1	1578.8	1409.8	1273.7
25	Immersion (TPc) tonne/	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
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.	38.6	43.2	47.7	52.5	57.5	62.6	64.7	66.4	68.4	70.6
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

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Team's members:

1. Team's leader: Oka Wicaksana Y
2. Vice leader : Muhamad Agahzi Z
3. Officials
   Head of division: Attha Dwi P
   Members :
   Muhammad Abdullah Azzam
   Ahmad Naufal Athaya
   Sri Nurhumairoh
   Wahyu Ardhi Santoso
   Ayuni Kusumadwitya
4. Mechanical
   Head of division : M. Fiqran
   Members:
   Agung Pratama Manurung
   Radon Panji Mujahiddin
   Furqon Sholehudin
   Febby Ari Saputro
5. Electrical
   Head of division : Ibrahim
   Member :
   Setiawan Nur Ikhsan
   Apriyan Purba
   Dimas Arfiantino
   Ahmad Zaid
   Michael MGP Simatupang

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