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Research Paper

About some applications of underwater gliders

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ABSTRACT: *This article highlights the importance of underwatergliders in : seas, lakes or oceans. This autonomousunderwatervehicle (AUV) isused in manyfields: education, research, military, etc.Theseunderwatergliders are able to move to specific locations and depths and occupycontrolled spatial and temporal grids,regardless of weather.Therefore, the glider moves bothhorizontally and vertically as it has variable buoyancy.The buoyancy system uses the density of the ocean for energy, withadditional batteries, so as to allow long endurance at lowcost. The underwatergliders are equippedwith a widevariety of sensors.Neverthless, theseautonomousunderwatervehicles (AUV)canbeprogrammed to patrol for weeks.But at some point, the underwatergliders must surface to transmit their data to shore whiledownloading new instructions at regularintervals, achievingsubstantialcostsavingscompared to traditional surface ships.*

KEYWORDS: *Float, Dive, AUV, Buoyancy, Sensors.*

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I. INTRODUCTION

An underwater glider (UG) is an autonomous underwater vehicle (AUV). Hence, instead of propellers or traditional thrusters, this AUV uses propulsion with variable buoyancy.

The underwater glider is an AUV capable of moving to certain locations and depths in the sea.Otherwise, the onboard buoyancy motor uses the density of the sea for energy, with battery backup, allowing for long endurance at low cost, as shown in Figure 1.

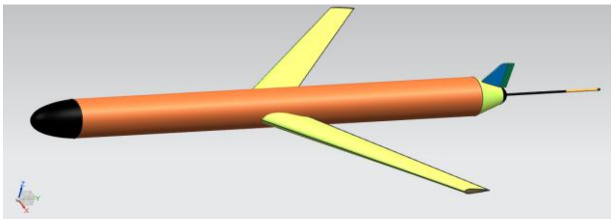

Figure 1: Underwater glider

Anyway, the long range and endurance capabilities of underwater gliders make them ideal for various missions at: seas, lakes or oceans, [1].

The model of the article has the following parameters, as shown in Table 1.

Table 1: Parameters of underwater glider

Measurement	Value	Unit
Length	2.10	m
Diameter	0.28	m
Span	0.110	m
Wing area	0.58	m^2
Weight	48	kg
Speed	0.23-0.33	m/s
Maximum depth	300	m

In practice, the most used types of underwater gliders are:Albac, Slocum, Spray, Liberdae XRAY, Seaglider, Dolphin, Sea shadow, etc.

II. CASE STUDY

The underwater glider looks like a torpedo that has no propeller or internal engine. Instead, the underwater glider uses a special pump to slightly change its buoyancy over time. Also, the underwater glider to slowly move up and down through the sea, is shown in Figure 2.

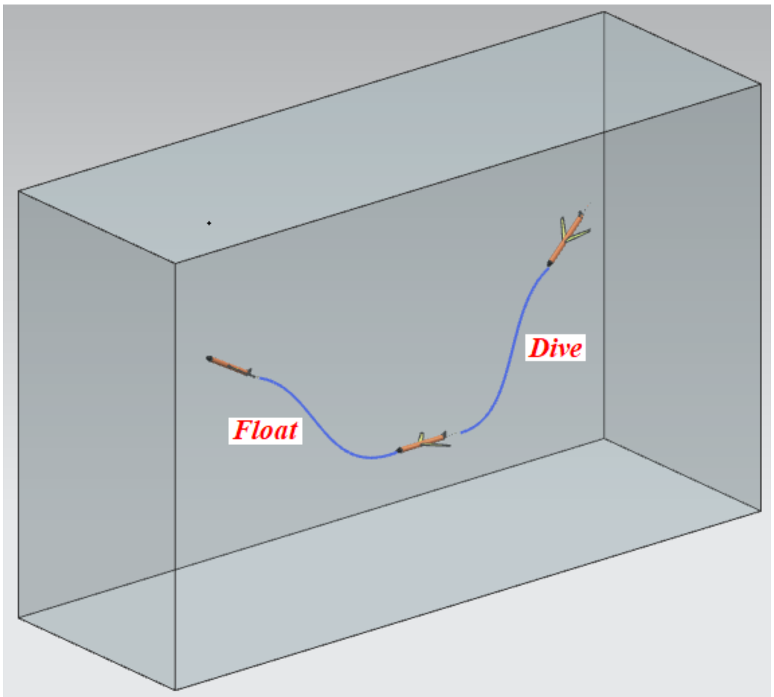

Figure 2: Moving of an underwater glider

Depending on the various types of missions, the gliders are equipped with a wide variety of sensors. Moreover, these underwater gliders can be programmed to patrol for weeks at a time and surface from the sea, only to transmit data ashore while downloading new instructions at regular intervals, achieving substantial cost savings, [2].

The body of the underwater glider is made of aluminum alloy 5086. Because, this aluminum alloy has a superior corrosion in seawater, moderate strength, good formabilityand lightweight, [3].

The main properties of the aluminum alloy 5086are shownin Table 2.

Table 2: Properties of the aluminum alloy 5086

Property	Value	Unit
Density	2660	kg/m^3
Melting point	858.15 – 914.15	K
Hardness, Brinell	78	-
Hardness, Vickers	88	-
Ultimate Tensile Strength	$290 \cdot 10^6$	Pa
Tensile Yield Strength	$207 \cdot 10^6$	Pa
Modulus of Elasticity	$71 \cdot 10^9$	Pa
Fatigue Strength	$150 \cdot 10^6$	Pa
Poisson's Ratio	0.33	-
Fatigue Strength	$150 \cdot 10^6$	Pa
Shear Modulus	$26.4 \cdot 10^9$	Pa
Shear Strength	$175 \cdot 10^6$	Pa

As in Figure 3, most underwater gliders are made of seven components: nose, pressure hull, fixed wings, tail, rudder and antenna.

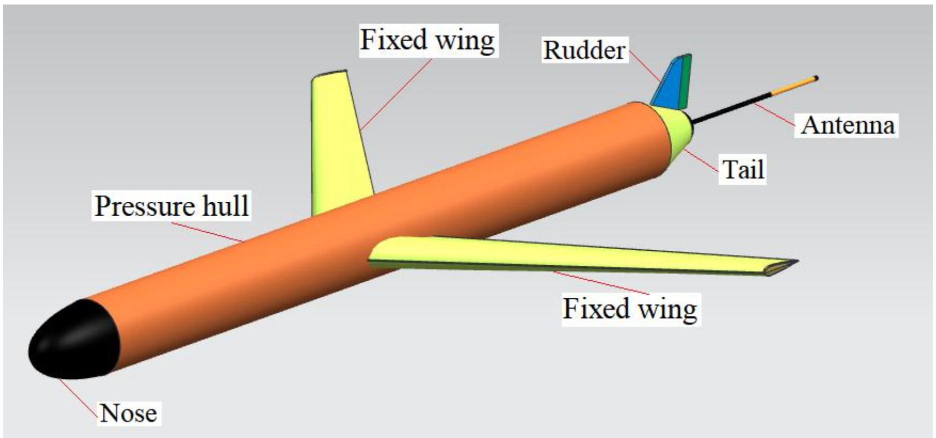

Figure 3: Components of underwater glider

AccordingtoFigure 4 depending on theresearchmissions, theunderwaterglider (UG)canbeequippedwiththefollowingdevices: nitrate sensors, hydracarbonsensors, active acoustics, altimeter, fluorometers, shadowgraphcameras, [4].

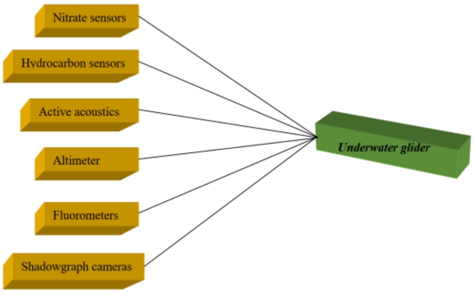

Figure4: Devices of underwater glider

For the fluid model, seawater at a salinity of S = 17 PSU (practical salinity units) and a temperature of T = 297.15 K was chosen, which is typical for the Black Sea, [5].
Meanwhile, the underwater glider is located approximately 1 m below the surface of the water. In addition, it controls the volume was large enough that gravity resulted in a significant static pressure difference between them up and down. In addition, buoyancy was also considered,as in Figure 5.

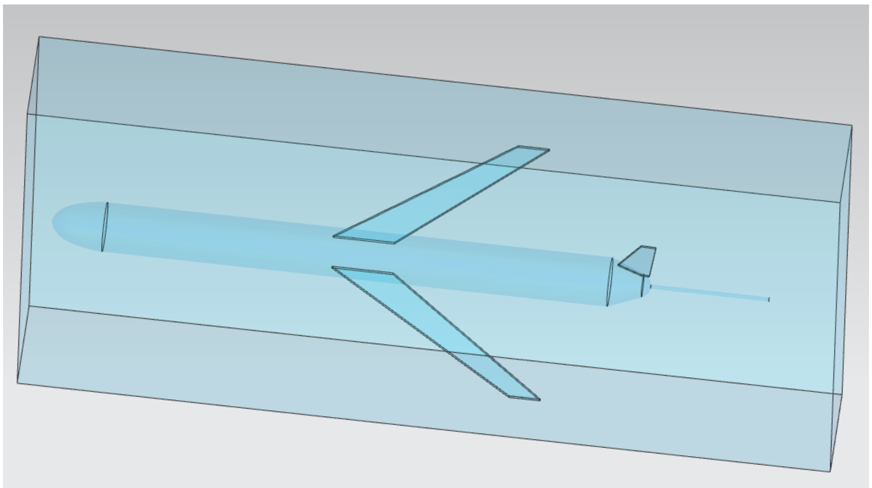

Figure 5:UG and fluid domain for CFD simulation

The velocity distribution changes around the underwater glider when it is fixed and the flow comes in front of it. Thus, in node 3170 (element 2140), there is the maximum velocity that has the value: v_{max} = 106.165 m/s. On the other hand, in node 1968 (element 1684), there is the minimum velocity that has the value: v_{max} = 76.7348 m/s, as in Figure 6.

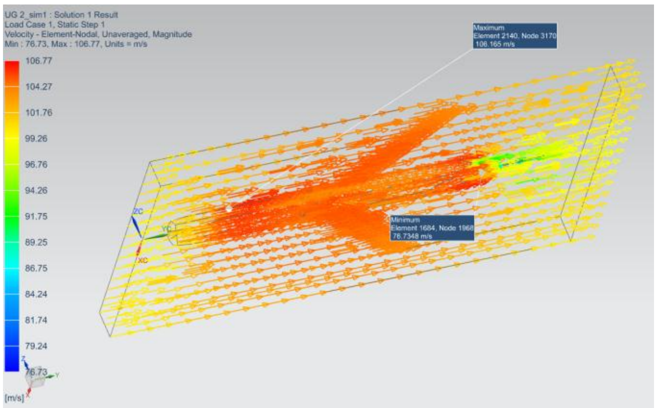

Figure 6: Velocity distributions around the underwater glider

Figure 7 presents Von Mises stress changes in different parts of the underwater glider, [6].

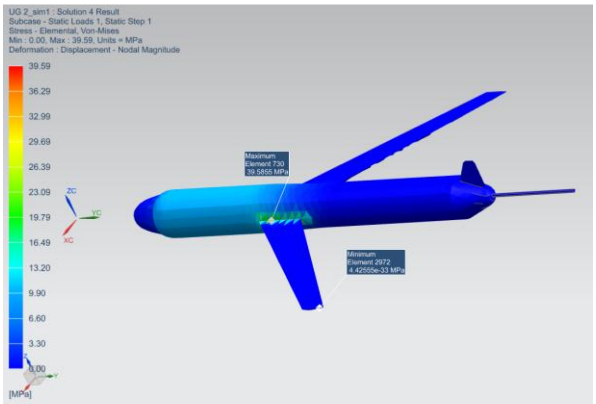

Figure 7: Von Mises stress variations

In the chosen nodes, all von Mises stress values are positive. And the maximum value of the von Mises stress is 38 MPa, as shown in Figure 8.

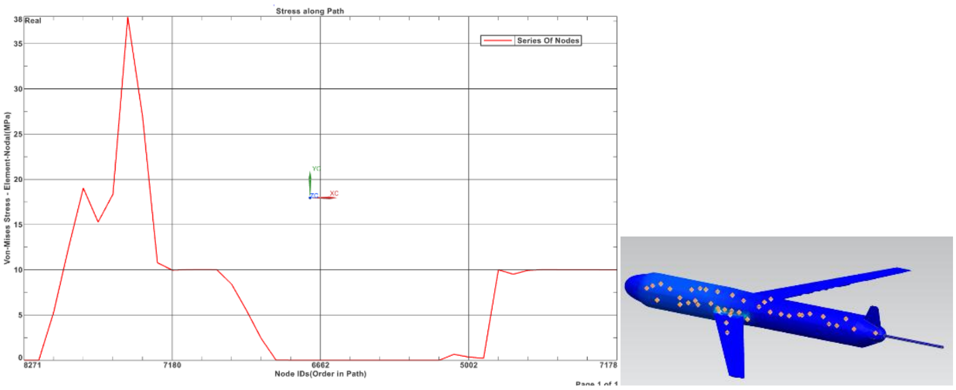

Figure 8: Von Mises stress – Nodes diagram

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III. CONCLUSION

The underwater gliders used in the seas bring a series of advantages to these ones, such as:

- covers long distances.
- can go on long term missions.
- are autonomous then are unmanned systems.
- are cheaper than other types of AUVs.
- data collection with the help of sensors is done in remote and safe places.

The choice of sensors for equipping an underwater glideris done accordingly with specific work assignments.

The underwater gliders can analyze and map the dynamic (temporal and spatial) characteristics of groundwater coastal waters around the clock and during the calendar. All at relatively low cost with minimal personnel and infrastructure

Currently, they are working on new underwater gliders models, so that the production cost is low.

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