

The Legal Regime Governing AUV Operations

How Far and How Wide

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Abstract— the last decade has seen an exponential growth in the legal literature looking at the applicability of the law as it relates to the operational use of Autonomous Underwater Vehicles (AUV). The legal views postulated in this burgeoning body of literature are varied and can be very driven by scenario [e.g. requirement for navigational safety] or by class of AUV operator [defence/academic]. The legality can also be further complicated when some vehicle operators are planning to operate a mix of unmanned maritime vehicles in the air, at the sea surface and underwater. Legal opinions are now being sought when concepts such as 'swarms', 'networks' and 'system of systems' are being mooted in the context of AUV operations. A new dimension is that AUV operators are now looking at ethical issues surrounding some types of AUV usage where complete autonomy is being considered. The area of ethics of robotics is a distinct entity its own right and has associated with it a defined body of law. This paper seeks to try and provide an up to date understanding of how applicable and broad the legal regime relating to the operation of AUVs is and will suggest how this may change as the use of AUV's becomes even more commonplace

Keywords- legal regime, AUVs, status, ethics, autonomy, persistent presence

I. INTRODUCTION

The paper uses a starting point the following leading question:

Is the certainty of the legal status of autonomous underwater vehicles (AUVs) a prerequisite for the unmanned underwater vehicle community to continue to operate and invest in the development of these vehicles, such that their presence for sustained periods of time in the world oceans becomes the norm?

In other words, does the AUV community need the reassurance that its activities are legal to ensure that a 'persistent presence' of AUV capabilities becomes the reality which is envisaged in this AUV2012 [<http://www.auv2012.org/>] conference?

This conference paper aims to try and provide an up to date understanding of how applicable and how broad the legal regime relating to the operation of AUVs is and will suggest how this may change as the use of AUVs becomes even more

commonplace. It is hoped that the paper will go some way to addressing the question posed at the start of the paper.

A. Scope of this Paper

This section outlines the scope of the paper by detailing the key concepts and published definitions relating to the legal issues arising from a consideration of the concept of a sustained presence of AUV capability in the world's oceans.

The following are the key characteristics that define an AUV and have been adopted from the Society for Underwater Technology (SUT) 'Recommended Code of Practice for the Operation of Autonomous Marine Vehicle – 2nd Edition' [1].

They are:

- (i) A man-made unmanned vehicle that operates in the marine environment;
- (ii) Not mechanically linked to, or restrained by, an operational/launch station (e.g. boat, submarine, shore station);
- (iii) Operating untethered (e.g. no fiber optic or wire communications link) and with no form of direct control (e.g. radio or acoustic, although it may also be capable of receiving and acting on further instructions);
- (iv) Capable of movement, with a horizontal component, relative to the surrounding water mass; and
- (v) Capable of onboard decision – making.

The scope of the paper also recognizes 3 classes of operator. The classes being:

- (a) Government [G] – This class of AUV primarily undertakes State funded marine scientific research (MSR). The class is also extended to include vehicles that deliver regulatory requirements such as aid to civil powers.
- (b) Commercial [C] – The operator class description contained in the SUT Code of Practice [1] for commercially operated AUVs is adopted for the purposes of this conference paper.

(c) Military [M] – This class of AUVs are only operated to undertake State defined military objectives. AUVs deployed by this class of operator are considered for the purposes of this paper to be ‘sovereign immune’ craft.

The basis for this description of [M] draws on pertinent material contained in a number of publications. These are:

- The United States Navy’s (USN) publication ‘The Commander’s Handbook on the Law of Naval Operations’ [2];
- The National Research Council publication ‘Autonomous Vehicles in Support of Naval Operations’ [3], and
- The USN publication ‘The Navy Unmanned Undersea Vehicle (UUV) Master Plan’ [4].

The scope of legal consideration covers the three levels of regulatory activity:

- State
- Regional
- International.

and also the three sources of regulation:

- Legislation
- Case Law
- Customary Practice – that is a general practice that is accepted as law. [taken from http://www.icrc.org/customary-hl/eng/docs/v1_rul_in_asofcuin]

B. Definitions Specific to Paper

This part of the paper provides a series of definitions that have been postulated primarily as framework to aid the delivery of the ideas for discussion and argument offered up under this topic. In no way should these specific ‘bespoke’ definitions be taken as an attempt at formulating new definitions that could be adopted in relation to the legal regime governing the development and operation of AUVs.

Persistent Present – in the context of this paper and in relation to AUV deployment is defined as the longevity of operation for a well defined mission objective in a bounded geographic location for:

- a single AUV or,
- a number AUVs deployed at the same time but each being individually operated or,
- a number of AUVs deployed but being operated by single operator as a network – ‘one mind one objective’

How Far – is defined in this paper as being the ‘extent’ to which AUV development and operations can be accommodated within the legal landscape.

How Wide – is defined here as being the ‘breadth’ of legislation type that will be impacted on by the development and operation of AUVs.

A Network of AUVs – is a term used in this paper to describe a collection of AUVs not necessarily all of the same class of vehicle that are being operated under the control of ‘one mind’ serving ‘one common objective’.

Autonomy – for the purposes of this paper the concept of autonomy is defined as the capacity contained in the vehicle that relies on the AUV to sense its own operating environment and then employing the maximum levels of freedom undertake independent decision making with the minimum of human intervention whilst operating out of line of sight.

There is an excellent review of autonomy and unmanned maritime systems in chapter 3 of the Finn and Scheduling book [6]. This review also extends to a consideration of network centric autonomy.

C. Setting the legal scene for the ‘persistent presence’ of AUVs

This short background section sets the scene by highlighting some of the key legal complexities that are likely to arise if the objective of a persistent presence of AUVs in the world’s oceans is to be achieved.

Of note with respect to the conference theme and this paper were the following observations which were made in a recent edition of *The Economist* [5] in an article published in its Science and Technology section entitled ‘Exploring the oceans – 20,000 colleagues under the sea’. The observations were that:

‘Ten years ago there were fewer than 30 ‘gliders’ in the world.....Now there are at least 400.....’

‘His (Dr Arima of Osaka University) plan is to deploy 1000 of them (gliders) in a network that surveys and measures the oceans’

The ‘Gliders’ are category of unmanned underwater vehicles that are relative newcomers to the AUV family of vehicles but are the largest group by numbers currently in operation. Their exponential growth in use as commented on in *The Economist* article can also be said to be true for the growth seen in the larger and powered category of AUVs that have been in operational existence for a longer period of time than gliders.

Reflecting on the second observation taken from *The Economist* article it is interesting to ask whether there will ever be one single class of operator who has the finances to buy and then operate, as a network, a thousand large powered AUVs for a sustained period of time.

So will ‘persistent presence’ of AUVs in our oceans be limited to just large numbers of ‘gliders’ being deployed in support of a requirement similar to that which is currently being addressed by ARGO floats? Or will ‘persistent presence’ be predicated on a mix of AUV types both powered and non-powered, with the powered forms allowing for a sustained geographic presence. For some unmanned underwater vehicle operators such as the defense community, ‘persistent presence’ may be based on an unmanned vehicle mix that includes AUVs, unmanned surface vehicles (USV) and maritime variants of unmanned air vehicles (UAV). This vehicle mix brings with it further potential for legal complications some aspects of which will become applicable to the broader AUV community in due course.

In summary the legal complexity surrounding a persistent presence for AUVs arises from a number of factors or considerations such as:

- The three classes of AUV operator [G], [C] and [M] who are likely to be viewed differently with in the three levels of regulatory activity.
- The current and potential range of AUV operations e.g. MSR, offshore oil pipe line surveys or military data gathering.
- The degree of AUV autonomy e.g. will there be a requirement for an ‘ethical’ protocol for AUVs that regulates the vehicles autonomous behavior with respect to ‘sensitive’ missions that have for example the potential to adversely impact on human life or the creation of wealth.
- The status attributed to vehicles by the different classes of owners e.g. is there a reliance on sovereign immunity for the AUV to achieve its objective.
- That some commercially supplied AUVs are being bought and operated by all three classes of operators giving rise to confusion by those coastal states seeking to regulate access to their water under current law such as the United nations Convention on the Law of the Sea (UNCLOS).
- The lack of a body of bespoke legislation central to the recognition of the AUV technology increases their vulnerability to criminal activity such as theft and vandalism.
- The lack of a body of bespoke legislation focusing on recognizing the AUV as a maritime entity akin to that formulated for other novel marine vehicles such as hovercraft. This shortfall can cause confusion amongst other maritime users as how to respond to their presence especially when they are being operated on the surface.
- A greater risk of harm to third parties due to increases in both numbers of AUVs and their size arising from the establishment of the persistent presence concept.
- A greater risk of harm to the marine environment due to increases in both numbers of AUVs and their size

arising from the establishment of the persistent presence concept..

The Dave Simonds cartoon used to illustrate The Economist article neatly captures through its imagery a number of the legal issues that will arise when a swarm of AUVs are operated to achieve a sustained capability in the oceans.

II. HOW FAR?

Single examples will be used to illustrate this aspect of the paper. The examples chosen will be used to discuss and illustrate the ‘extent’ to which AUV development and operations is accommodated within the legal landscape as it exists now and will need to be in the future. The examples selected being:

- AUVs and UNCLOS [Now]
- AUVs and COLREGS [In the Future]

A. How Far – Now?

The example used here is Part XIII of the United Nations Convention on the Law of the Sea (UNCLOS) [7]. This part of the Convention defines the regulatory framework that deals with the subject of MSR and as such provides both the Coastal State and the Researching State direction on how to manage the activity of MSR with the various maritime zones defined in UNCLOS.

In 1991 a guide was produced by the UN to aid States Parties in their implementation of this part of the Convention. The guide provided draft forms to aid States in respect to the application for consent to conduct MSR. It should be noted that the text of the Convention does not explicitly make reference to AUVs, a fact that was reflected in the forms contained in the 1991 version of the guide. This early guide was reviewed and updated in 2010 by a panel of UN experts. A number of the panel members were draw from the international science community who had extensive experience of using AUVs to undertake State funded MSR. The panel’s knowledge of this new form of delivering MSR saw the application form *Draft Standard Form A* amended at *Section 4 - Methods and Means Used* to recognize that MSR was now being undertaken by AUVs.

The new *Sub Section 4.3 – Particulars of AUV* asks for the following information from the Researching State:

Name:
Manufacturer and make/model:
Nationality (Flag State):
Website for diagram and specifications:
Owner:
Operator:
Overall Length (meters):
Displacement/Gross Tonnage:
Cruising and Maximum Speed:
Range/Endurance:

Method and Capability of Communication (Including Emergency Frequencies):
Details of Sensor Packages:
Other Relevant Information:

The use of these forms to make application for MSR is not currently a mandatory requirement but has through 'customary practice' been established as the accepted methodology for making MSR requests. This example of accommodation into existing legislation is significant as it assigns 'status' to AUVs in the context of access into Coastal States waters all be it primarily for only one class of vehicle that is Government.

The recognition of AUVs in the revision of the UN Guide and the forms contained therein is indicative of the limited extent to which legislators are willing address this matter. That is a willingness to amend the 'implementation' process but not to tackle the 'substance' of the legislation.

B. How Far – In the Future?

The example used here is the Convention on the International Regulations for Preventing Collisions at Sea 1972 COLREGS [8]. Previous published literature [9] and [10] on the legal regime of AUVs has considered the extent of the impact or application of over twenty maritime conventions. Most of these Conventions come under the auspices of the International Maritime Organization (IMO). COLREGS has been chosen as this has been the subject of much scrutiny and discussion with in the unmanned maritime vehicle community in general [11] and AUV specifically [9] over the last few years.

It appears from analysis of the references that this is because the Convention contains two key aspects of import to the AUV community. That is the definition of a 'vessel' and a set 'navigational rules' with the requirement to adhere to the latter being dependent on being compliant with the former.

At the nub of this is interests are the following COLREG Rules:

'PART A - GENERAL

Rule 1

Application

(a) These Rules shall apply to all vessels upon the high seas and in all waters connected therewith navigable by seagoing vessels.

and

Rule 3

General definitions

For the purpose of these Rules, except where the context otherwise requires:

(a) The word "vessel" includes every description of water craft, including non-displacement craft, WIG craft and seaplanes, used or capable of being used as a means of transportation on water.'

A large number of commentators [6], [9] and [10] subscribe to the view that AUVs fit with in the Rule 3 definition and as such the weight of the Convention can be brought to bear on the operation of AUVs in the maritime environment without recourse to changing the Convention.

That said there is also a growing literature [11] and [12] that seeks advocate amending COLREGS to be more explicit in including AUVs with in the articles primarily dealing with definitions but also those relating to navigational safety. It should be noted that this new diverging trend is because of a rising interest in operating large USVs. A lead champion for going to the IMO with proposed changes to COLREGS has been the European Defense Agency (EDA) who through the work of its 'Safety and Regulations for European Unmanned Maritime Systems' (SARUMS) working group has within the last year embarked on a programme of work to draft amendments to the regulations.

These proposed amendments are to ensure that both USVs and AUVs come unequivocally within the bounds of this important piece of legislation. If EDA are successful in this activity then having an established piece of international legislation that contains a definition which is explicitly inclusive of unmanned vehicles is likely to have far reaching consequences. Especially when the AUV community comes to consider the applicability of the myriad of other maritime conventions.

III. HOW WIDE?

At the time of the AU2012 conference the collective AUV community will have had experience of a relatively broad spectrum of incidents [13] e.g. loss of vehicle, criminal damage to vehicles and third party issues. It is suspected that a large number of these incidents have not involved recourse to legislation and subsequent appearances in court for these matters to be resolved.

Almost certainly any issues that have occurred involving AUVs have been resolved privately. This statement can be made with a certain amount of confidence because at the time of writing no case law has been identified, specifically involving the operation of AUVs. This is an interesting fact when it is borne in mind that AUVs have been around for well over two decades.

Though it is observed, that currently there is no bespoke legislation in respect to the operation of AUVs it does not mean that the design, manufacture, selling, buying, operation and disposal of AUVs is undertaken in a legal vacuum. Of course, there exists a body of legislation at all levels of regulatory activity that governs the AUV world. Some of that legislation impinges quite significantly on the capacity to

operate AUVs as a persistent presence most notably at present is UNCLOS.

It is forecast that the spectrum of influential legislation in relation to future AUV capability will only get broader. This will be partly due to the AUV community moving to embrace existing legislation as has been mentioned earlier with the example of EDA SARUMS and COLREGS.

It will also be due to the ongoing innovation which remains prevalent within the AUV community. This will see these new technological advances in areas such as novel sources of power or greater autonomy come within the sphere of growing new legislative arenas such as ethics and robotics [6], [10] and [14].

IV. FINAL ARGUMENT

It is argued here that unmanned maritime system in general and AUVs specifically have been operated in the worlds oceans for over two decades. AUVs are bought and sold as a commercially sustainable product. This has occurred and is occurring without recourse to a bespoke body of AUV legislation. Therefore, what is the imperative on the AUV community to seek to change this status quo? It is argued there is no over riding driver for change. It is further argued that the best approach is to let any legal vacuum be addressed by 'customary practice' and if necessary recourse to the courts. If this approach is adopted then the necessary continued innovation by the AUV community will not be stifled and the goal of a 'persistent presence' will be achievable.

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