Pushing the envelope on SUAS use in OSR operations: the rise of a dedicated service tool?

Project "HazGuard drone".

Lt. Charles-Henri Thouaille
French Navy counter pollution expertise and response unit (CEPPOL).
charles-henri.thouaille@intradef.gouv.fr

Introduction

Responding to maritime pollutions, be they caused by oil spills or chemical spills, requires a high level of situational awareness. Not only is it of paramount importance to obtain reliable visual information on the situation at the earliest possible opportunity, but the acquisition of environmental data *in situ* can greatly increase the chances of safe response operations. Recent developments in the commercial availability of SUAS as well as equipment that would have been too heavy or expensive to be considered for deployment by off the shelf SUAS now allow custom built solutions to be developed.

Various commercially oriented drone programs are undergoing development. A new service trend appears to be emerging whereby UAS surveillance data is used to complete satellite imagery. At this stage, however, very few partners seem to have developed custom built solutions for the OSR field. Project HazGuard drone (Hazardous Material Guardian Drone), a French navy innovation project led by CEPPOL, aims to develop a proof of concept integrated aerial system capable of operating in a hazardous environment at sea during maritime emergency response operations.

Building on CEPPOL's 2015 investigation of the integration of SUAS in OSR operations (Thouaille, 2016), this project further investigates the ability of such platforms to act as a force multiplier in spill response operations thus pushing the envelope on using SUAS in oil spill response operations and maritime emergency response in general.

Main Results

As evidenced by the rise in use of SUAS presence in the media, small unmanned air systems, also known as drones, have established a strong presence in the world. Having evolved from large, complex and costly systems used mostly by the military, they seem to have become a staple gadget - with 416 000 units sold in France alone in 2016 (Quenet, 2017) - and have certainly become a tool in many industries (IDG UK, 2018). Many use cases exist for such systems: from automated "last mile delivery" (McKinsey & Company, 2016) to surveillance (FLIR unmanned air systems) or industrial uses (Offshore energy today, 2017). Their widespread availability, variety and ability to deploy various types of payload provide us with new ways to conceive many operations. However, as of yet, there are very few systems dedicated to operational spill response (see for example: (Shenzen JTT Technology Co., ltd, 2017)).

CEPPOL's 2015 investigation in the use of SUAS as an operational force multiplier firmly established the potential of SUAS in oil spill response operations. However, the scope of this particular research was limited to off the shelf systems. Drawing on the lessons learnt from the previous investigation and nearly 40 years of operations, CEPPOL embarked on a new project: designing and testing an SUAS capable of not only helping on scene coordinators in their asset tasking and deployment but also monitoring operational parameters such as VOCs and various gas concentrations while maintaining a rapid air/maritime picture. In short, such a system could not only see and transmit, but also smell, log and map its findings in a user friendly way. Time critical, safety conscious decisions could be optimized, saving OSCs precious time and providing incident commanders valuable insight without risking lives or wasting time. These are the mission parameters of project *HazGuard*.

One of the few hurdles identified in the course of CEPPOL's 2015 was the necessity to adhere to a legal framework still very much in its infancy. While France has had a clear legal framework for the use of SUAS since 2012, the quick development of the industry in that area and the steep rise in number of SUAS sold to professionals and hobbyists alike has raised a number of concerns (Le Monde, 2015; Les Echos, 2014). These concerns range from safety to security issues. Since 2015, the framework has been in constant evolution: two ministerial orders were passed in December 2015 (JORF, 2015), a law in January 2016 (JORF, 2016) and another order in 2017 (JORF, 2017).This framework pertains only to civilian SUAS, military systems are dealt with by an altogether different set of rules (JORF, 2013) which has also been evolving rapidly.

Until recently, national frameworks were the rule; however, the European air safety agency is working on a European framework that could bring about a measure of homogeneity at European level (European Air Safety Agency, 2017). Comparable processes have been occurring elsewhere and tell a similar story: a structural movement is afoot that will shape the future of a promising industry (Moingeon, Chisholm, & Lefranc, 2017). The current state of regulatory affairs means that SUAS use in OSR operations or maritime emergencies must, for the moment, be approached on a case by case basis. Once a wider consensus is reached on professional standards and a more uniform approach to flight authorisation processes is reached, it is this author's opinion that the main hurdle to SUAS use and adoption by the OSR community will have been removed, thus paving the way for a comprehensive service offer in this area.

Oil spill response, and maritime emergency management in general, are areas in which SUAS use can bring high operational benefits for a relatively minor investment. Tethered aerial observation systems (Hovpod, 2017) or aerostats (Vikoma international Ltd, 2018) can be used to provide constant air cover and surveillance when the casualty is situated far from the shore. The use of SUAS in surveillance or monitoring seems an established trend (Chevron corporation, 2017). However, at this stage, while there is a commercial offer for surveillance services or products, the trend does not yet seem to have spread to a comprehensive solution allowing the federation of all this information on an immediately exploitable GIS. This is where project HazGuard's innovation aims to bring added value.

Project HazGuard was proposed by CEPPOL to the DGA (French defence and technology development and procurement directorate) as a "participative innovation" project to tackle this issue. Once completed, this system, comprising a light weight airframe transporting a 4kg payload, will be able to carry out surveillance missions monitoring visual (visible spectrum & thermal IR) and environmental parameters (various airborne particulate and gas sensor readings). All this information will be fed back to the operator through a mesh modem and logged onto an operational geographic information system (GIS) thus allowing the operator to produce an accurate picture not only of potential spills (mapping of slick) but also of environmental parameters such as benzene concentration (for example) or VOCs (in general), CO, H_2S, explosimetry and O_2 concentration. Such consolidated information will allow OSCs to choose the right approach vectors for ships or simply to choose the right PPE for OSR teams.

This particular idea stems from two lessons identified over the course of decades of operational deployments and exercises:

- incident commanders often find it difficult to obtain *in situ* measurements of potentially dangerous gases and other environmental parameters in the immediate vicinity of a casualty (stricken vessel…) or a spill within the first few hours ;
- the choice of adequate PPE is often complicated in the early hours of an incident due to the fluctuating level of information available on the nature of the product spilled or its actual behaviour.

In order to overcome this information deficit, and because information gathering in crises is often an iterative process that demands numerous queries and constant fact checking, first responders are faced with the following dilemma: wait until more is known, thereby loosing precious intervention time, or maximising the level of protection available to the responders, thus potentially complicating their intervention needlessly.

HazGuard, once it has reached fruition, should shorten the initial information gathering sequence and provide the incident commander / on scene coordinator with a rapid initial operational assessment as well as a high refresh rate should that prove necessary.

Conclusion

In order to satisfy the demands of emergency management at sea, responders are increasingly relying on SUAS to provide them with additional situational awareness. Satellite imagery and regular aircraft flyby missions are being completed with *ad hoc* reconnaissance missions flown directly from the theatre of operations. Advances in sensor miniaturisation and connectivity coupled the widespread development of SUAS for professional and recreational uses have enabled responders to tailor SUAS to meet their specific needs (Foxwell, 2017).

Service offers in the field of SUAS data acquisition (for inspection purposes, engineering, communication…) have developed over the past few years at a rapid pace. However at this stage, data collection has mostly remained in the field of imagery. A few examples of environmental parameters monitoring do exist (Scentroid , 2015), but very few that seem to meet the needs of spill response or remediation operations off the shelf. Once completed, project HazGuard will enable CEPPOL to integrate visual and thermal data acquisition with environmental monitoring. Our aim is to produce a dual information flow transmitted directly to the operator and the on scene coordinator, consisting in a video feed and a GIS map of airborne particulate concentrations as well as gas concentration readings (if the need arises, this information could be bounced back to a central command post allowing the incident commander a better view of operations in near real time). This information will serve two purposes: risk assessment (mapping concentration threshold, PPE choice, and approach vectors for intervention units…) and asset coordination (guidance of OSRVs and vessels of opportunity) maximizing their utility at sea. Pending results of the trials, additional sensors could conceivably be integrated to the meshed array (AIS beacon for example) to further enhance the on scene coordinator's situational awareness.

References

Chevron corporation. (2017, February). *Deploying drones for emergency response*. Retrieved January 24, 2018, from www.chevron.com: https://www.chevron.com/stories/deploying-drones-for-emergency-response

European Air Safety Agency. (2017, May 4th). Notice of Proposed Amendment 2017-05 (A).

FLIR unmanned air systems. (n.d.). *PD-100 PRS*. Retrieved January 24, 2018, from http://www.proxdynamics.com: http://www.proxdynamics.com/products/pd-100-black-hornet-prs

Foxwell, D. (2017, January 12). *Oil spill responders expect growing role for unmanned aerial vehicles.* Retrieved January 24, 2018, from Offshore Support Journal: http://www.osjonline.com/news/view,oil-spill-responders-expect-growing-role-for-unmanned-aerial-vehicles_46054.htm

Hovpod. (2017). *Tethered drones*. Retrieved January 24th, 2018, from HovPod.com: http://www.hovpod.com/products/drone-platform/tethered-drones/

IDG UK. (2018, January 10). *Best uses of drones: How 25 companies are using drones*. Retrieved January 24, 2018, from www.techworld.com: https://www.techworld.com/picture-gallery/apps-wearables/best-uses-of-drones-in-business-3605145/

JORF . (2017, April 8). *Arrêté du 30 mars 2017 modifiant l'arrêté du 17 décembre 2015 relatif à l'utilisation de l'espace aérien par les aéronefs qui circulent sans personne à bord.* Retrieved January 24, 2018, from Légifrance: https://www.legifrance.gouv.fr/eli/arrete/2017/3/30/DEVA1703912A/jo/texte

JORF. (2013, December 29th). *Arrêté du 24 décembre 2013 fixant les règles relatives à la conception et aux conditions d'utilisation des aéronefs militaires et des aéronefs appartenant à l'Etat et utilisés par les services de douanes, de sécurité publique et de sécurité civile qui ci.* Retrieved

January 26th, 2018, from Légifrance: https://www.legifrance.gouv.fr/eli/arrete/2013/12/24/DEFD1329241A/jo/texte

JORF. (2015, December 24th). *Arrêté du 17 décembre 2015 relatif à l'utilisation de l'espace aérien par les aéronefs qui circulent sans personne à bord.* Retrieved January 26th, 2018Légifrance: https://www.legifrance.gouv.fr/eli/arrete/2015/12/17/DEVA1528469A/jo/texte

JORF. (2015, December 24th). *Arrêté du 17 décembre 2015 relatif à la conception des aéronefs civils qui circulent sans personne à bord, aux conditions de leur emploi et aux capacités requises des personnes qui les utilisent.* Retrieved January 26, 2018, from Légifrance: https://www.legifrance.gouv.fr/eli/arrete/2015/12/17/DEVA1528542A/jo/texte

JORF. (2016, october 24th). *LOI n° 2016-1428 du 24 octobre 2016 relative au renforcement de la sécurité de l'usage des drones civils (1).* Retrieved January 26, 2018, from www.legifrance.fr: https://www.legifrance.gouv.fr/eli/loi/2016/10/24/2016-1428/jo/texte

JORF. (2017, April 8). *Arrêté du 30 mars 2017 modifiant l'arrêté du 17 décembre 2015 relatif à l'utilisation de l'espace aérien par les aéronefs qui circulent sans personne à bord.* Retrieved January 24, 2018, from Légifrance: https://www.legifrance.gouv.fr/eli/arrete/2017/3/30/DEVA1703912A/jo/texte

Le Monde. (2015, January 29). *Au total, 17 sites nucléaires ont été survolés par des drones depuis octobre*. Retrieved January 24, 2018, from www.lemonde.fr: http://www.lemonde.fr/planete/article/2015/01/29/dix-sept-sites-nucleaires-ont-ete-survoles-par-des-drones-depuis-octobre_4565967_3244.html

Les Echos. (2014, January 2nd). *Survol des centrales nucléaires : un drone pris en chasse par un hélicoptère militaire*. Retrieved January 24, 2018, from www.lesechos.fr: https://www.lesechos.fr/02/12/2014/lesechos.fr/0203982932839_survol-des-centrales-nucleaires---un-drone-pris-en-chasse-par-un-helicoptere-militaire.htm

McKinsey & Company. (2016, September). *Parcel delivery, The future of the last mile.* McKinsey & Company - Travel, transport and logistics.

Moingeon, B., Chisholm, L., & Lefranc, E. (2017, December 7). *The Day Of The Drone -- How Flying Robots Are Revolutionizing Business.* Retrieved January 26, 2018, from Forbes.com: https://www.forbes.com/forbes/welcome/?toURL=https://www.forbes.com/sites/hecparis/2017/12/07/the-day-of-the-drone-how-flying-robots-are-revolutionizing-business/&refURL=https://www.google.com/&referrer=https://www.google.com/

Offshore energy today. (2017, February 15). *Sky-Futures wins global drone inspection gig with Eni*. Retrieved January 24, 2018, from www.offshorenergytoday.com: https://www.offshoreenergytoday.com/sky-futures-wins-global-drone-inspection-gig-with-eni/

Quenet, M. (2017, February 26th). *Les drones de loisir cartonnent auprès du grand public*. Retrieved January 24th, 2018, from www.lejdd.fr: http://www.lejdd.fr/Societe/Les-drones-de-loisir-cartonnent-aupres-du-grand-public-850268

Scentroid . (2015). *Flying laboratory DR1000.* Retrieved January 26th, 2018, from www.scentroid.com: http://scentroid.com/scentroid-dr1000/

Shenzen JTT Technology Co., ltd. (2017, June 06). *UAS - UAV Inspection & monitoring solutions for oil & gas*. Retrieved January 24, 2018, from www.jttuav.com: http://en.jttuav.com/article/detail/172.html

Thouaille, C.-H. (2016). *Optimizing the use of aerial surveillance assets in oil spill response operations: the case for using SUAS as a force multiplier in spill response coordination.* Brest: Journée annuelle du Cedre 2016 (unpublished as yet).

Vikoma international Ltd. (2018). *Hawk Owl*. Retrieved January 24, 2018, from Vikoma.com: https://www.vikoma.com/Oil_Spill_Solutions/Ancillary/Hawk_Owl.html