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RESEARCH ARTICLE

Evolving Markets of Commercializing Underwater Vehicle Technology

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Abstract: Underwater vehicle (UV) technology has gone through stages where academic curiosity was followed by research investigation and prototype development. Applications have recently surfaced that seem to have sufficient financial backing to develop operational systems. Certainly the timing of UV technology was good. It has been able to leverage its development by utilizing many technologies developed for other markets. The next five years will see the expansion of UV technology into the commercial marketplace. The size of that market is unclear but the move into the marketplace has begun. There are still many important research investigations to be undertaken. Autonomy is probably the most important issue to be addressed but others, such as those described above, certainly must be addressed. The development of autonomous underwater vehicles (AUVs), and their introduction into the military and offshore markets, has been a slow and costly process. This paper will provide an overview of those using and developing AUVs, discuss the state-of-the-art, and provide a projection on where the technology is heading and the hurdles it must overcome to reach maturity.
Keywords: Underwater vehicle, market, autonomy, remote operable

I.INTRODUCTION

The global underwater vehicle (UV) fleet is increasing and demand for autonomous underwater vehicles (AUV) is expected to show steady growth over the period to 2018. The UV technology continues to improve, their use is expected to become more widespread opening up markets in regions where UVs are currently less commonplace [1]. The rate of UV build has been in the order of 75 units per year, but this is expected to double to around 150 within five year's time. Sectors of the UV market are already rapidly maturing and the value of the technology is receiving widespread acceptance in applications such as deepwater seabed mapping for the oil & gas industry, in ocean research and mine counter-measures surveys [2].

The sector is also evolving, with pre-commercial activity evident in oil & gas life-of-field and pipeline inspections, together with increasing use of low-logistics vehicles and those designed for shallower waters and flexible deployments. In addition there are potentially significant developments in many areas and for ultra-long endurance missions in both the ocean research and military sectors. Individual sections discuss the fundamental technologies of positioning and obstacle avoidance; main vehicle components such as umbilical cables, tooling, survey sensors, cameras and manipulators. UVs have moved from a state of research and development, through operational demonstrations and have now reached the beginnings of commercial acceptance. Significant resources have been expended to date in the development of payloads and the associated software for this vehicle architecture. The mechanical, electrical, and logical interfaces are very specific to this vehicle architecture, as it is for all UV architectures and manufacturers [3]. The control software between the payloads and the main vehicle computer, that controls the overall mission, is also unique.

II.THE UNDERWATER VEHICLES

During the later years of the 1990's, the commercial survey community first began investigating the possibility that UVs to solve the problems facing by the oil and gas industry. Even civil engineers are beginning to understand the economics. Optimal structural design versus over-design saves the oil & gas industry millions every year; however, this is only workable when the engineers have the essential data they need. The UV appeared to solve both problems – excellent data acquisition capabilities at an affordable price [4]. Another issue on UV economics centred on the efficiency of vehicle operations, especially whether it was best to have one multi-role or several single-role vehicles. Several economic evaluations, based on manufacturers 1999 prices, seemed to point towards 'bigger is beautiful'; however, there is more to the answer than simple economics. Smaller vehicles are easier to handle and are more portable, can be operated from vessels of opportunity and offer some flexibility for sensor packages. Others have also evaluated the commercial economics and all agree that AUVs offer savings in time, commercial risk and operational cost [5].

III. REMOTE OPERABLE VEHICLE

Remote operable vehicles (ROV) are tethered and under the full control of an operator, most often on a ship. The tether can transmit high definition video in real time and give instant access to the operator. ROV have been used successfully for decades by the offshore oil & gas industry with only gradual improvement [6]. Recent computer vision is enabling the ROV to gradually automatically identify objects and assist the operator. Increasingly, the operator will relinquish control tasks to the ROV, improving consistency and reducing the required amount of training for operators. A discernible transition of ROV to AUV has occurred over the last few years. A new class of so-called “hybrid ROV” offers the ability to untether the ROV so it maneuvers autonomously. The engineering complexity is high, and these systems are not yet proven. Short range high-bandwidth acoustic modems enable the ROV to roam freely yet transmit decent amount of data in real time. Optical communication presents high bandwidth but of very limited range. Hybrid ROVs are completely autonomous, relying on docking stations to charge their batteries, most often by induction, and to upload their data wirelessly. Such systems allow the use of hybrid ROVs for months at a time. AUV integrators are usually the ones taking on the engineering challenge, since ROV integrators are missing the critical piece of autonomy as a core technical competency.

IV. AUTONOMOUS UNDERWATER VEHICLE

Autonomous underwater and semi-submersible vehicles, be they AUVs or hybrids, have important roles to play in the offshore environment [7]. They may not yet be a complete substitute for many traditional ship-based methods of data acquiring, or replace the ROV as a construction support and intervention vehicle, but they do hold the prospect of becoming an indispensable tool for engineers and surveyors alike. AUVs also offer the prospect of augmenting much traditional data acquisition for charting and navigational surveys and for surveying the resources within national economic zones. Already military and defense organizations have recognized the value of autonomous robotics in such areas as mine counter measures, a subject outside the scope of this paper, and much of the research in this area is exportable to more peaceful applications. As has already been stated, much of the world’s seas and oceans remain something of a mystery [8]. Here the AUV has perhaps its most important role, as a science platform, to gather information on the properties of the oceans and as an observer of the dynamic events that take place beyond the view of humans.

The AUV is a unique vehicle class, it comes in many shapes and forms, and operates in ways similar to unmanned space probes; they are, in fact, inner-space probes. As tools to collect data from the medium that covers the majority of our planet, the environment that drives much of our fragile climate, they are the most logical and most efficient machines capable of collecting data from the sea surface to its greatest depths. Research around the world continues apace, developing ever-better autonomous systems and improving the range of sensors that science demands. A great deal of effort has been, and continues to be, focused on better and more efficient energy sources that allow the vehicles to stay at sea for longer and to power more sensors.

V. CONCLUSION

AUVs are now at an early stage of acceptance. As they work their way into the phase of operational acceptance on a commercial level, their numbers will grow. Academia is not only using AUVs but also spinning off firms to supply commercial versions. And the US Navy is gearing up to push the technology, ensuring that cost-effective systems are available for use by the fleet in the future. But the future will hold more than the acceptance of the “standard” AUV, it will begin to see the Hybrid AUV/ROV emerge. Today, the number of all electric ROVs, such as the Quest ROV developed by ALSTOM Schilling Robotics, is increasing. These more efficient vehicles will increase system reliability and eventually provide cost-effective components that will become available for use by AUVs.

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