Ocean Sci. Discuss.,
https://doi.org/10.5194/os-2018-88-AC4, 2018

Ocean Science
Discussions

Interactive comment on "Deep-sea search and recovery: with and without operating an underwater vehicle" *by* Tongwei Zhang et al.

Tongwei Zhang et al.

tongwei.zhang@outlook.com

Received and published: 26 December 2018

We thank the Reviewer for the comments, which have helped us improve our manuscript. Our responses are in blue.

The paper describes traditional methods for the search and recovery of objects lost at the deep sea and it also describes a new system for this search-recovery problem. This new system seems interesting in practice; however, some points should be discussed in the study: Response: We thank the Reviewer for this positive and detailed comments. 1. The sections 2, 3, and 4 basically describe the objects that are typically lost at the deep sea and the methods for searching and rescuing them. These sections are long and do not include any new scientific contribution. They

could thus be reduced and merged into the introduction. Further, some parts of these sections seem to lack reference, for example line 9-13 on page 2, line 5-10 on page 3, line 1 on page 4, line 21-23 on page 6, and line 14-19 on page 7. Response: We thank the Reviewer for this comment, however, we do not agree completely with the Reviewer on this point. Section 2, 3 and 4 give the basis of the new deep-sea recovery system proposed in Section 5. All these sections constitute an organic whole of this paper. (1) Section 2 presents a general description of deep-sea search and recovery objects. From this section, one can obtain a general idea of deep-sea search and recovery objects, such as whether their location is known or not, their weight in water, their dimensions, and so on. These are needed for the designation of a new deep-sea recovery system in Section 5. (2) Section 3 gives the basic methods and equipment for deep-sea search. Before recovery and salvage, we should obtain the accurate position of the object. According to the accuracy of the object position, the new deep-sea recovery system proposed in Section 5 uses 3D real-time imaging sonar for early detection of salvage objects. (3) Section 4 analyzes the deep-sea recovery process and typical recovery cases based on operational underwater robots. It shows that there are many difficulties in practical application, such as the requirement for a special technical maintenance and protection team, and very high diving costs. Therefore, there is an urgent need for a low-cost deep-sea recovery system which proposed in Section 5. Furthermore, 8 references are added. [1] 1966 Palomares B-52 crash: https://en.wikipedia.org/w/index.php?title=1966_Palomares_B-52_crash&oldid=873145370, last access: 18 December 2018. [2] Air France Flight 447, https://en.wikipedia.org/w/index.php?title=Air_France_Flight_447&oldid=873450197, last access: 18 December 2018. [3] Autonomous Benthic Explorer, http://www.whoi.edu/main/ABE, last access: 18 December 2018. [4] Echoscope, https://www.codaoctopus.com/products/3d/echoscope, last access: 18 December 2018. [5] 370, https://en.wikipedia.org/w/index.php?title=Malaysia_Airlines_Flight_370&oldid last access: 18 December 2018. [6] Nereus (underwater vehicle), https://en.wikipedia.org/w/index.php?title=Nereus_(underwater_vehicle)&oldid=853247050,

last access: 18 December 2018. [7] Soviet submarine K-278 Komsomolets, https://en.wikipedia.org/w/index.php?title=Soviet_submarine_K-278_Komsomolets&oldid=861297786, last access: 18 December 2018. [8] Space Shuttle Challenger disaster, https://en.wikipedia.org/w/index.php?title=Space_Shuttle_Challenger_disaster&oldid=87344 last access: 18 December 2018. 2. The objective of the study could be clearer at the end of the Introduction (lines 22-25 on page 1). Especially, the last sentence (line 25 on page 1) lacks precision. Response: We thank the Reviewer for this comments. The part in question is rewritten as follows: The remainder of this paper is organized as follows. Section 2 presents a general description of deep-sea search and recovery objects. Section 3 gives the basic methods and equipment for deep-sea search. In Section 4, we analyze the deep-sea recovery process and typical recovery cases based on operational underwater robots. In Section 5, based on the design concept and working model of TV-grab in oceanographic studies, we propose a new type of deep-sea recovery system to perform the recovery process. Finally, we summarize this paper in Section 6. 3. The new system proposed in the publication is very well described in section 5. However, even though it has not been tested in the field yet, some deeper discussion regarding the outcomes of its use should be presented in this study (costs, time of operation, possible damages on the lost object during grabbing or others). Further, a detailed scientific methodology should be considered to substantiate the discussion. Response: We thank the Reviewer for this positive and detailed comments. “5.4 Discussion” is added as follows: 5.4 Discussion The new deep-sea recovery system is designed based on the concept of the TV-grab used in oceanographic studies. TV-grab does not need a technical support team in the practical application (Clark et al., 2016). The working model of the new deep-sea recovery system is similar to that of TV-grab. It only requires two or three people to operate. The cost of the new deep-sea recovery system in a practical application is much lower than the existing deep-sea recovery systems that are based on the deep-sea operation of ROVs and HOVs. Furthermore, as shown in Figure 3, most of

the onboard parts already exist on modern integrated ships and only a few units need to be added. Thus, the cost of building the new deep-sea recovery system is also very low. The new deep-sea recovery system is easy to launch and retrieve like TV-grab. It can operate in the ocean bottom for a long time. The docking/gripping system of the new deep-sea recovery system includes an actuator and drive mechanism that supports repeated opening and closing for handling salvage objects. If no dynamic positioning is available, the ship centers on the position of the salvage object and floats at low speed. The onboard operator can see the actuator and the salvage object from the camera and choose the appropriate part of the salvage object to grip. However, the buoyancy material or sensors may be damaged when the actuator grips the salvage object. 4. The recovery system seems to be designed to be directly connected to the winch of the vessel. In this case, the motion of the vessel would be coupled to the recovery system, inducing possible high dynamic effects on the system. How would these effects interfere with the searching process and with the controllability of the system (especially during the grabbing phase)? Response: We thank the Reviewer for this comments. (1) To minimize the motion effect of the ship, the ship should have a dynamic positioning system. If no dynamic positioning is available, the ship centers on the position of the salvage object and floats at low speed. (2) The recovery operation should be operated under level 4 sea conditions. Like TV-grab, operating in high-level sea condition will be very dangerous. In this tentative study, we only consider good sea conditions. High sea condition is beyond the scope of this study, but we will consider it in our future studies. 5. Subsea lifting operations are ruled by some international standards, such as DNV- OS-H205, DNV-OS-H206, and DNV-RP-H103. How does the operation described in page 14 (especially lines 17-26) comply with these regulations? Response: We thank the Reviewer for this comment. (1) Because the new deep-sea recovery system is similar to TV-grab, we use the working model of TV-grab for reference when describing the recovery process in Section 5.3. (2) In this tentative study, we refer to relevant standards, such as “General Rules for Diving and Underwater Operations”, and “Requirements for Unmanned Remote Control

Submersible Cooperative Diving Operations". (3) In the future, we will improve this new deep-sea recovery system to meet international standards. We will give serious consideration to the international standards, such as DNV- OS-H205, DNV-OS-H206, and DNV-RP-H103.

Please also note the supplement to this comment:
https://www.ocean-sci-discuss.net/os-2018-88/os-2018-88-AC4-supplement.pdf

---

Interactive comment on Ocean Sci. Discuss., https://doi.org/10.5194/os-2018-88, 2018.