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The valuation for the feasibility and applicability of SfM on the deep sea topography

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J-MARES (Research and Development Partnership for Next Generation Technology of Marine Resources Survey, JAPAN) has been designing a low-expense and high-efficiency exploration system for seafloor hydrothermal massive sulfide deposits in “Cross-ministerial Strategic Innovation Promotion Program (SIP)” granted by the Cabinet Office, Government of Japan since 2014.
In this program, we are trying to reconstruct seafloor topographical models by using Structure from Motion (SfM) technique. In recent years, a kind of photogrammetric method for high resolution reconstruction, especially SfM, has become a powerful and widely used tool for three-dimensional (3D) topographic modelling (e.g. for analyzing gully and/or landslide features). This technique can reconstruct 3D models from overlapped images through the fully automated feature-matching algorithm. Moreover this technique doesn’t demand the high capital investment costs, heavy equipment and complexed analyses in comparison to other kinds of traditionally topographic surveying such as terrestrial laser scanning (TLS). By taking advantage of these features, SfM has democratized access to photogrammetric modelling and encouraged a wide range of uses in geomorphology. On the other side, because of the underwater environment conditions characterized by non-uniform lighting, poor visibility due to scattering and absorption in the medium, there are still few applications of SfM to underwater topography.
In this report we will make the brief introduction for our study that aims to evaluate the feasibility and applicability of the movie taken in deep sea to reconstruct 3D model using SfM technique. The sample movies have been acquired by Remotely Operated Vehicles (ROV) in deep sea around Japan. Considering ROV’s moving velocity, video resolution and subject distance to targets, the still images are captured as a serious of strongly overlapped images. Then the images are combined with the coordination information logged by ROV using the recording time of the cut images to give coordination and scale for the reconstructed 3D model. In these obtained models available to detect structure within several centimeters, it is possible to draw sectional views, and analyze surface areas and section volumes. On the other, factors that impede matching accuracy, such as positional accuracy problems, floating matter in the sea, fluctuation of seawater caused by hot water, etc. are clarified and are under consideration as future tasks.