19 Learning to search like human

Adaptive spotting for efficient object search

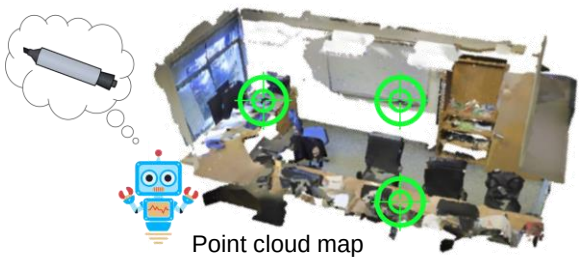
Abstract

We propose Adaptive Spotting, a deep reinforcement learning approach to object search from a scene represented by a 3D point cloud map. A straightforward approach using exhaustive search is often not promising due to poor computational efficiency. To solve this problem, our approach simultaneously learns the features of a given object and its efficient search path. Our network is designed to have a pose estimation module to estimate promising locations to be explored. The network is trained in an end-to-end manner to learn efficient search paths by using a reinforcement learning strategy that gives a higher reward when it finds the target in fewer search steps. Evaluation results demonstrate that our approach outperforms several state-of-the-art methods in both search accuracy and the number of search steps required. It is expected to be used in areas such as logistics, manufacturing, and transportation, which require the ability to search for objects in 3D space fast and accurately.

Point Cloud Search

Search for object with certain shape in point cloud map of space captured by 3D sensor (LiDAR, etc.)

Space often huge and non-uniform
⇒ Exhaustive search is often undesirable.

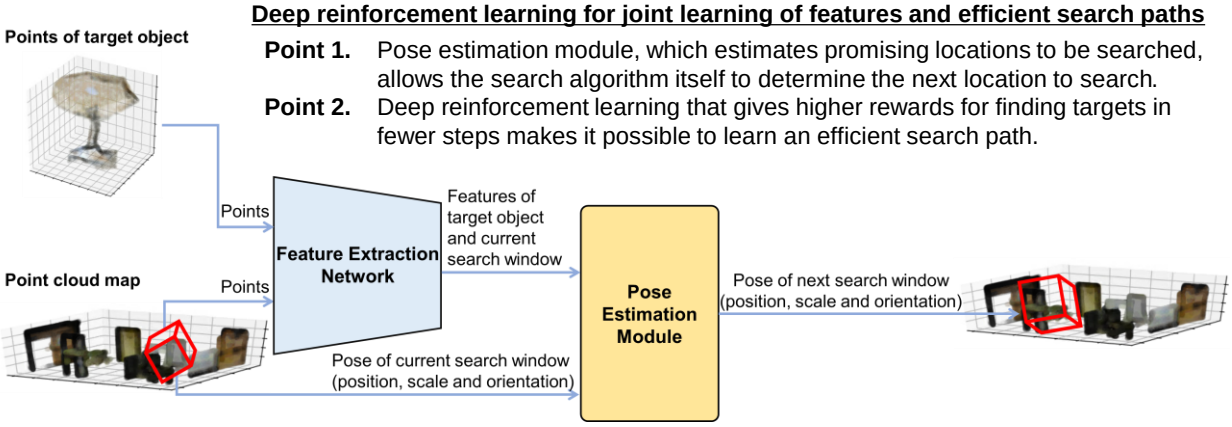


Adaptive Spotting

Deep reinforcement learning for joint learning of features and efficient search paths

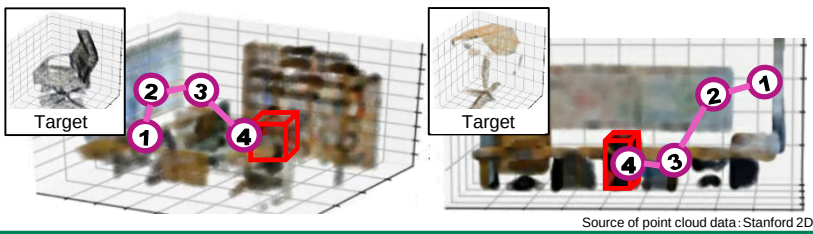
Point 1. Pose estimation module, which estimates promising locations to be searched, allows the search algorithm itself to determine the next location to search.

Point 2. Deep reinforcement learning that gives higher rewards for finding targets in fewer steps makes it possible to learn an efficient search path.



Examples of Search Paths (Searching chair in office room)

Possible to find target within a few steps



Performance improved significantly

Source of point cloud data : Stanford 2D-3D-Semantics Dataset http://buildingparser.stanford.edu/dataset.html

References

[1] O. Krishna, G. Irie, X. Wu, T. Kawanishi, K. Kashino, "Learning search path for region-level image matching," *Proc. IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP)*, 2019.

[2] O. Krishna, G. Irie, X. Wu, T. Kawanishi, K. Kashino, "Deep reinforcement template matching," *Meeting on Image Recognition and Understanding (MIRU)*, 2019.

Contact

Onkar Krishna Email: cs-openhouse-ml@hco.ntt.co.jp
Recognition Research Group, Media Information Laboratory

オープンハウス 2020