

GA3C for Anomalous Radiation Source Detection

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Abstract : In order to reduce the risk of radiation damage that personnel may suffer during operations in the radiation environment, the use of automated guided vehicles to assist or replace on-site personnel in the radiation environment has become a key technology and has become an important trend. In this paper, we demonstrate our proof of concept for autonomous self-learning radiation source searcher in an unknown environment without a map. The research uses GPU version of Asynchronous Advantage Actor-Critic network (GA3C) of deep reinforcement learning to search for radiation sources. The searcher network, based on GA3C architecture, has self-directed learned and improved how search the anomalous radiation source by training 1 million episodes under three simulation environments. In each episode of training, the radiation source position, the radiation source intensity, starting position, are all set randomly in one simulation environment. The input for searcher network is the fused data from a 2D laser scanner and a RGB-D camera as well as the value of the radiation detector. The output actions are the linear and angular velocities. The searcher network is trained in a simulation environment to accelerate the learning process. The well-performance searcher network is deployed to the real unmanned vehicle, Dashgo E2, which mounts LIDAR of YDLIDAR G4, RGB-D camera of Intel D455, and radiation detector made by Institute of Nuclear Energy Research. In the field experiment, the unmanned vehicle is enable to search out the radiation source of the 18.5MBq Na-22 by itself and avoid obstacles simultaneously without human interference.

Keywords : deep reinforcement learning, GA3C, source searching, source detection

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