Deep learning for automated detection and tracking of undersea pipelines

Deep learning is currently one of most popular technologies in several industries and application areas. It has consistently exhibited significantly superior performances in almost all areas of artificial intelligence including computer vision, speech recognition, machine translation, big data analytics and automatic game playing. Particularly, deep learning has taken the field of computer vision by storm through convincingly winning several global competitions involving tasks such as image segmentation, object detection and classification. In this task, we will study application of deep learning for similar image processing operations in the context of underwater pipeline inspection.

Regular external inspection is a very important activity in maintenance of undersea pipelines in several industries including the oil and gas industry. Inspection can be performed manually or semi-manually using an underwater vehicle remotely operated from a mother ship. But the cost involved with such an approach is very high. A much more economical approach would be to employ an autonomous underwater vehicle (AUV) which is equipped with the suitable imaging sensors and the intelligence required to take the necessary actions without help from a manual operator. FFI in cooperation with Kongsberg, has developed such an autonomous underwater vehicle called Hugin, which is fitted with sonar imaging sensors as well as optical cameras. In the proposed task, images collected by Hugin will be analyzed using deep learning techniques.

The objective of the proposed work is to extract the parts of the image that represent the pipeline with the help of deep learning based segmentation algorithms. This should be achieved in different ways depending on different scenarios. One of the scenarios arises when the AUV is tracking the pipeline with the intention of navigating along the pipeline. In this case, the image of the sea floor and the pipeline is created gradually using sonar signals, and hence segmentation should be carried out gradually. A suitable tool for this scenario is a recurrent neural network (RNN). Another scenario arises in inspection when an image is taken with the optical camera at a specified position of the pipeline. Then the whole image can be segmented using a convolutional neural network (CNN) and the pipeline pixels can be extracted. Both the RNN and the CNN can be trained on the available image data using deep learning algorithms. Typically, hundreds of thousands of images are required to successfully train a deep learning network. But it is known that previously trained networks can also be adapted to new tasks. The latter approach will be followed in this work. Depending on the interests of the candidate the task definition can be modified within the framework outlined here.

Preferred background of the candidate: Python or similar scripting language; some experience with C/C++; familiarity with image processing, statistics, Linux; interest in machine learning

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