# Crack detection in inspection by a fusion of computer vision and machine learning methods

DNV GL, Høvik and Trondheim,
in cooperation with Prof. Rudolf Mester, IDI

## Background

DNV GL has actively researched how to apply computer vision and machine learning techniques to automation of our remote inspection services.

Currently, we are running an NFR project, Autonomous Drone-based Surveys of Ships in Operation (ADRASSO), which aims to develop computer-vision-based framework to automate the DNV GL ship survey process. The application scenario is that an autonomous drone equipped with RGB cameras flies within a ship tank and inspects the condition of the tank by taking videos. The videos taken by the drone might be processed either on-board of the drone for real-time (defects detection) display and navigation guidance of drone flight path, or offline at the DNV GL office premise using a highly reliable and robust defect detection model.

To develop such a computer-vision-based pipeline, we have investigated several state-of-the-art object recognition models including object classification (image-level), object detection (bounding box + localization), and semantic segmentation (pixel-level) to detect the existence of a particular type of detects, i.e., cracks, in static images. Both object detection and semantic segmentation models have achieved very good results on our static ship survey images. However, we still face the challenges:

- The number of false positives ('false alarms' is to be kept as low as possible
- To achieve a very low false negatives rate (missed cracks) is very critical for the whole application.

Since the ultimate goal of the ADRASSO project is to analyse videos to reliably detect actual cracks while not generating too many false positives, we can utilize the temporal-spatial correlation of videos to combat the weakness of the object detection model.

This setting defines the environment for several research topics that can be addressed individually, or in a cooperative manner by several students.

## (1) Object detection + multiple objects tracking

Object tracking is a well-studied area. Our unique challenge is that we use a moving camera (the camera equipped in the drone) to track stationary objects (i.e., cracks). This is in some particular aspects different from the widely used object tracking techniques which are developed to track moving objects.

Thus the **first research question** is to investigate whether a task-dependent selection of existing tracking algorithms can be directly applied to tracking the detected cracks.

The **second research question** within this task is to investigate how to combine temporal-spatial correlation of videos to reduce the false outputs (both false negatives and false positives) of the object detection model? Here, we have a direct link to Task 3, where motion estimation is used to estimate the motion of the camera.

More specifically, we have an object detection model trained on our ship survey images, but it generates too many false alarms when running it on the videos capturing cracks. By utilizing the temporal-spatial correlation of videos, it should be investigated whether we can

- Identify in which frame the actual crack(s) is correctly detected?
- Track the correctly detected crack(s) over frames?
- Remove most of false positives?
- Reduce the false negatives?

Contact person: Prof. Rudolf Mester, IDI, Rudolf.Mester@ntnu.no