Objective and Explainable Image Quality Assessment

Scenario

An objective and explainable method for quantifying the quality of an image is required to inform manual and algorithmic evaluation of imagery within the Surveillance domain. Providing a quantitative understanding of the quality of an image will enable more accurate communication of algorithm performance to military users to both inform situational awareness and actions to be taken to improve the imagery fed into subsequent algorithms for analytics.

There are two scenarios to be considered:

1. Across all Surveillance domains there is an enduring requirement to detect, recognise and identify (DRI) areas of interest within dynamic environments captured through imaging electro-optical and infrared (EO/IR) cameras. Image degradations may be introduced through low-light (e.g. insufficient photons or contrast), turbulence (e.g. geometric distortion caused by irregular air motion), obscurants (e.g. haze/fog/smoke), insufficient lens performance, low sensor resolution or short exposure time.
   In this case, a quantitative metric would inform the quality of an image when degraded by atmospheric conditions or lens and sensor constraints. This metric may be used to advise on actions to take to actively mitigate the degradations (e.g. changing exposure settings).
2. Across Defence, synthetic imagery is required to augment datasets for training algorithms for DRI. There are many approaches for synthetically generating data, but understanding their efficacy in different use cases requires continued exploration.
   In this case, a quantitative metric could inform the efficacy of synthetically generated data when compared to real-world data and advise the use for algorithm training.

Constraints

The method must:

- Be explainable, such that the military user would have the situational awareness of what scene characteristics make the image higher/lower quality;
- Have low computational algorithm burden for low size, weight and power deployment of solutions (e.g. edge processing);
- Be generalisable to different environments or generalisable to an evolving environment;
- Be capable of quantifying quality within scenes with targets at different scales/distances from the camera (including short ranges (10s of metres), medium ranges (100s of metres), and longer ranges (1-20km) from the camera).

Task

Find or devise an objective and explainable algorithm(s) for quantitatively assessing the quality of imagery captured through EO/IR cameras. Considerations may include either individual or a combination of mathematical approaches.

