

TD-Info 2019 Innovation Challenge

Explainable Machine Learning in the context of Defence

Award sponsored by TD-Info members:



Finalists in the TD-Info 2019 Innovation Challenge were invited to exhibit at [Defence Information 2019](#), an annual two-day event jointly planned by MOD and TD-Info on behalf of Industry. Read more [here](#).



The organisers are grateful to the judges: **Nigel Whitehead** (BAE Systems CTO & Chair TD-Info), **Col Eddie Corrigan** (MOD Future Concepts, Defence Logistics) and **Phil Wright** (Innovation, MOD ISS). The judging criteria were: Genuine Innovation, Uniqueness in the Market, Maturity of the Solution and Relevance to the Challenge.

Congratulations to [DIEManalytics¹](#) (DIEM) for their winning submission provided [here](#)



Our experience

DIEM’s first AI/ML tools were developed in 2011 to help pension funds choose which hedge-funds to invest in. Contrary to popular belief, AI/ML in finance is not a purely automated process; investors need to understand on what basis the AI/ML is making recommendations prior to investing.

However, the outputs of the best performing AI/ML techniques e.g. neural-net and deep-reinforcement-learning, are not readily explainable.

So, we developed an AI/ML ‘overlay’ approach: Our AI/ML solution learns how the underlying ‘unexplainable-AI/ML’ learns, using combined AI/ML tools, and generates three types of explanation:

- *Explicit:* The specific reason for the AI/ML output based on the values of the inputs;
- *Implicit:* The drivers of the reason for the AI/ML output; and
- *Relative:* The frequency that the AI/ML output is the best solution for the given inputs.

The choice of which type of explanation to exploit depends on the particular use-case and user.

¹ “DIEManalytics Ltd is the defence arm of DIEMconsulting Ltd, and specialises in developing visual models, simulations, and decision-aides to help make more effective defence decisions.” Source: [website](#)

Examples of applications

Figure 1 illustrates our different AI/ML tools, the domains they were applied in (defence and civil) and highlights those which exploit our approach to AI/ML explanation (purple links).

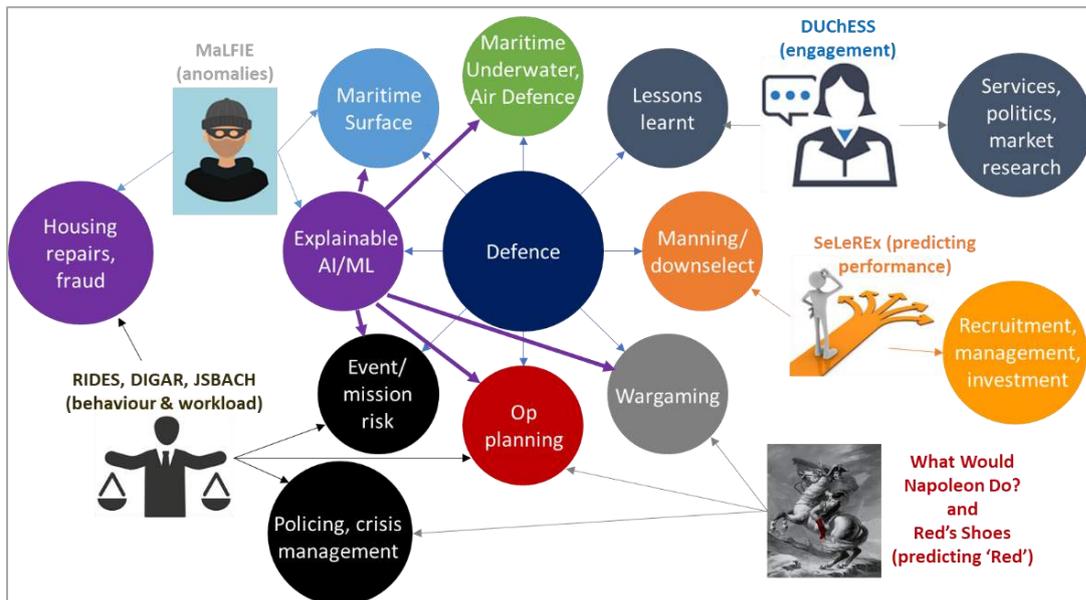


Figure 1: DIEM's AI/ML experience in the defence and civil sectors

The most recent example of our approach to explainable AI/ML in defence is project MaLFIE (Machine-Learning Fuzzy-logic Integration for Explanation), which was DASA-funded [Defence and Security Accelerator] and Programme NELSON sponsored. This takes the Automatic Identification System (AIS) data from surface vessels to detect and explain anomalies - and prioritises which vessels should be investigated further.

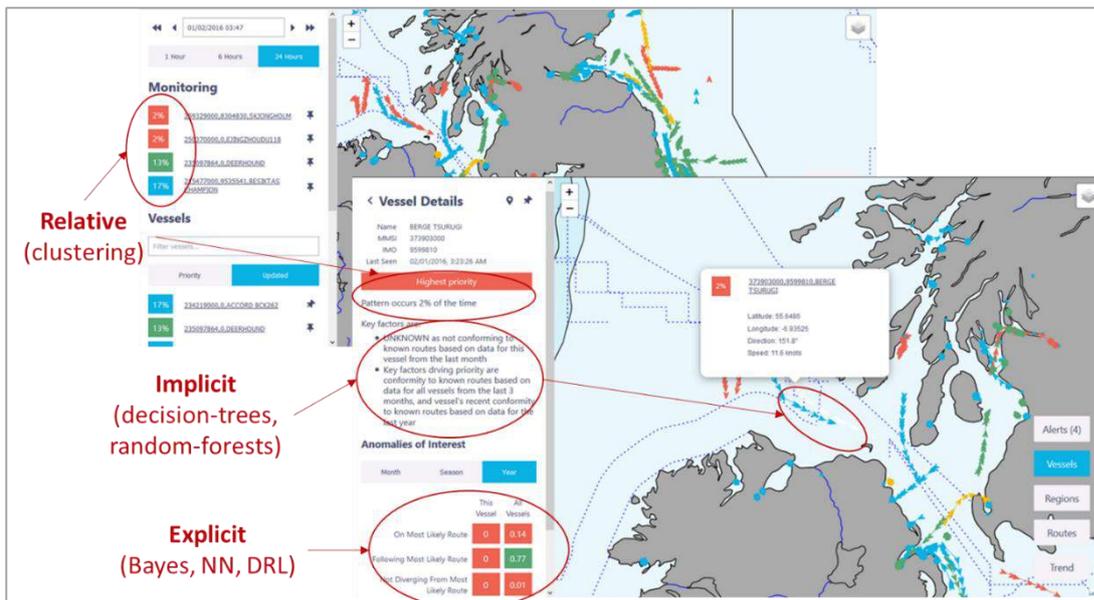


Figure 2: Screenshots from the MaLFIE application, highlighting styles of explanation and techniques used

Figure 2 shows the different types of explanation (including Royal Navy-style natural language explanation) the MaLFIE application outputs and how it identifies the priorities for action.