The Challenge

The European Commission has declared technology as the EU's top priority for the next five years. More particularly, one key objective is the mastery and ownership of key technologies in Europe.

With this objective in mind the European Defence Challenge asks the students of Europe to propose one or more work approaches dealing with topics such as artificial intelligence, autonomous vehicles, batteries, cybersecurity, chip technologies, control, robotics, signal and image processing, and related to defence technologies within the framework of the question mentioned above.

Please, defend your proposal by including not only technological, but also socio-economic, political, ethical and/or environmental aspects.

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European Defence Challenge II edition

Headline: Two-scale ambush prediction augmented with Artificial Intelligence

Today's European defense operations are mainly focused on peacekeeping operations, counter-terrorism and fighting piracy. Soldiers are accustomed to asymmetrical warfare rather than conventional war. Notably, the new missions faced by the armies are by far less deadly than previous open conflicts. Indeed, the relative technological supremacy of European armies results in an increased use of remote operations, which are less risky.

Yet, as of today, field operations remain highly dangerous. Ambushes are responsible for many casualties, especially in counter-terrorism missions. Such attacks generally combine two elements to succeed. First of all, the environment has to be favorable. In most cases, ambushes take place in areas that provide places to hide and the possibility to trap the allied soldiers. That is why forests and rocky areas are privileged. The second element is, naturally, the possibility to place explosives beforehand to initiate the attack.

To make ground operations safer, we propose a two-scale solution to anticipate ambushes, enriched with Artificial Intelligence (AI).

The macroscale solution we propose is to highlight areas with high ambush risk based on AI and prior expert knowledge. This can be achieved using two assets. First, thanks to satellite imagery, European armies have a global vision of the operation area. This relies on pre-existing strong capabilities of European armies, earned notably with a long history of partnerships with private companies and public agencies. A preliminary analysis establishes some topographical criteria of risk, based on prior human experience. For instance, forests surrounded by mountains are naturally associated with increased risk of landmines. Using computer vision and machine learning, the areas matching the criteria can then be highlighted, providing a large-scale estimation of dangerous areas.

Based on this analysis, another machine learning model highlights risky areas by taking into account previous ambushes and detected landmines. Technically speaking, the model can be trained with the locations of all landmines previously detected, including those from past missions, and combine these data in the optimal way to extract all relevant information. Combining topographic analysis and landmine locations prediction, one can reach a refined estimation of the ambush risk on the field. The Mines Advisory Group is already testing this technology to achieve a similar goal in areas where previous conflicts took place. We propose to unfold this approach to operational context.

In addition to the macroscale solution, we propose to develop a microscale asset based on drones and AI. When entering an area which has been classified as risky by the macroscale analysis, military staff will launch a "scout" drone. This drone will only require two board multispectral and infrared cameras. Hence, an easy-to-deploy low-cost commercial drone flying at low altitude can be used. First, a camera pointing towards the horizon will provide a global point of view to locate enemy movements. This can be automatically achieved using image recognition techniques. Secondly, a camera pointing to the ground will aim at finding landmines at finer level based on Convolutional Neural Networks. As of today, a plentiful literature exists on precise and reliable image recognition techniques in a broad number of areas.

The solution presented above combines well-known existing technologies, in a way which requires little additional means and training. Above all, this will drastically reduce risks that soldiers are taking on field operations.