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DOSSIER DE PRESSE

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INNOVDAYS

Quantum applications across Thales' markets

Cold atoms

The ultimate inertial measurement unit

Aircraft, submarines and surface ships are equipped with inertial measurement units, which use accelerometers and gyroscopes to determine the trajectory of the platform. But because their precision deteriorates over time, present-day inertial measurement units need be calibrated or fix their positions using GPS or celestial navigation techniques. Cold atom technology in quantum sensors will be 100 times more precise and open up numerous new possibilities in applications requiring reliable, fully autonomous navigation capabilities.

"NV" centres in diamonds

Toward 5G communications management

The ever-increasing number of connected objects (3G, 4G, WiFi, digital radios, television signals, etc.) is leading to growing congestion of the frequency spectrum dedicated to communications. It is becoming necessary to organise and optimise this space on an ongoing basis. The energy cost of this spectrum management will only increase in the future, particularly with the deployment of 5G. It is therefore essential to find new ways to manage this colossal mass of communications economically. The nitrogen-vacancy (NV) colour centre in diamond is an atomic-scale quantum sensor. It is the basic element of a compact, energy-efficient device that can measure the spectrum in real time. This function is essential for dynamic management of communications.

Spectral Hole Burning (SHB)

Comprehensive threat detection

To protect a ship from potential dangers, all types of threats need to be detected as quickly as possible, especially considering that some of them may be approaching the ship at very high speeds. But so many different types of threats exist today that they have to be detected one after the other – because recognising the radar signature of a boat or a plane, or detecting an incoming missile, cannot be handled in the same way or at the same time.

The properties of certain optical crystals can be exploited in quantum memories or quantum computers and also to instantly analyse all these signals, whatever their characteristics. This technology was demonstrated in real-world conditions in Brest harbour in 2019. Civil applications are also being investigated.

Quantum antennas

A revolution in communications

Each type of communication needs a particular type of antenna. To receive FM radio in a car, for example, a about metre-long antenna is required, while radio systems with very long range capabilities (hundreds of kilometres) need antennas measuring tens of metres! But many onboard or embedded systems have strict size and weight constraints. These constraints can be overcome by the quantum antennas being developed at the CNRS-Thales laboratory in Palaiseau. With this new approach to antenna physics, superconducting materials (operating at -200°C) can be used to reduce antenna size by a factor of up to 10,000 (for long-range communications). In addition, the technology makes it possible to use the same antenna for several types of communications.

Artificial nano-neurons

Energy-efficient AI

Artificial intelligence is at the heart of many impressive tasks such as image recognition and machine translation. However, AI algorithms running on conventional computers consume huge amounts of energy, which is an issue for the environment as well as a limiting factor for embedded applications. One promising research path is to take inspiration from the human brain, which consumes as little as a light bulb, to build novel computers that are less energy-hungry. The CNRS-Thales lab at Palaiseau is studying how to use nanometric-scale magnetic devices (a thousand times thinner than a human hair) as artificial nano-neurons. In 2017 and 2018, the team performed two first proofs of concept – and published the findings in the prestigious journal Nature – demonstrating that a nano-neuron could recognise spoken digits, and that a network of four nano-neurons could learn to classify vowels.

Quantum cryptography

Secure communications guaranteed by the laws of physics

Quantum cryptography exploits the laws of physics to share secret encryption keys between two parties. Exploratory work was carried out almost 10 years ago to evaluate the potential of this technology for products requiring highly secure communications. In particular, a full-scale demonstrator produced by Thales and its academic partners has been installed and tested on fibre optic networks connecting remote nodes on a metropolitan scale.

More recently, the same idea has been implemented for space communications by China. Several programmes are being launched on a European scale. Thales, in association with its academic partners, is widely recognised as a major player in this field.