Quantum Sensing for Rail Positioning using a Cold Atom Interferometer

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Global Navigation Satellite Systems (GNSS) are ubiquitous in navigation applications where they are used for high accuracy positioning, navigation and timing (PNT). However, GNSS is vulnerable to spoofing and jamming and does not work underground [1]. Inertial Navigation Systems (INS) are an alternative technology that position a platform in the absence of GNSS. However, they are limited by the drift in the underlying accelerometers and gyroscopes and are therefore unsuitable for long term accurate positioning. Cold atom quantum accelerometers and gyroscopes offer a potential solution, and have demonstrated an order of magnitude improvement in drift compared to conventional classical sensors within the lab environment [2,3]. The enhancement provided by quantum sensors can be used to produce highly accurate and secure positioning of trains, resulting in increased capacity and improvement in the ability to accurately locate faults on the railway network [4].

The railway environment is very harsh, there is significant variation in magnetic fields and a considerable amount of vibrations. In this poster, I will detail the work undertaken by Imperial College London to develop a quantum accelerometer and gyroscope that can operate in a railway environment [5]. I will discuss the results of our latest field trial on the London Underground network. During which a sub $10\,\mu K$ cloud of ^{87}Rb was consistently produced on a moving train. This is a significant step forward for the technology as it demonstrates that these sensors can function in a rail environment.

References

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