

## Evolution Of A Suite Of Smart Millimetre Wave Radar Systems For Situational Awareness And Automation In Mines

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**Abstract-**This paper defines the issues required for the development of successful visualisation sensors for use in open cut and underground mines. It examines the mine environment and considers both the reflectivity of the rock and attenuation effects of dust and water droplets. Millimetre wave technology, as an alternative to the more commonly used laser and sonar implementations, is selected due to its superior penetration through adverse atmospheric conditions. Of the available radar techniques, frequency modulated continuous wave (FMCW) is selected as being the most robust. The theoretical performance of a number of 94GHz FMCW millimetre wave radar systems is determined and these confirm the capability of these sensors in the mining environment. The paper describes implementations of FMCW radar sensors for simple ranging, two dimensional line scanning and three dimensional imaging that are based on a common ranging module and in the case of the 2D and 3D applications, a common swash-plate mirror scanner. Data obtained during field trials in mines is presented to justify the selection of this technology.