# Applications and Analysis of Commercial Millimeter-wave Radar Sensors in a Student Project at Metropolia UAS

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## Abstract

A low-cost millimeter-wave technology project included as part of the 15 ECTS course implementation of Sensor technologies is introduced in this paper. The primary learning objectives of the project were related to radar technology and applications, millimeter-waves, microstrip antennas and antenna arrays. Commercial low-cost easy-to-use mm-wave radars at 24 GHz and 61 GHz radars were used in the project. The secondary objectives were innovative goals, since the students were expected to create different applications of the hardware available. The radar equipment is based on FMCW technology (Frequency Modulated Carrier Wave) and the antennas are microstrip antenna arrays (multiple different layouts). The FMCW technology with an integration time of multiple seconds allows very accurate distance and axial velocity measurements. It's possible to detect whether a person is in a room even without the person moving at all (with the 24 GHz radars) and even measure the breath and heart rates of the person (with the 61 GHz ones).

In this paper the mm-wave radar technology of the radars in presented briefly together with the project results and future actions. Since the mm-waves are discussed, it's definitely worth discussing somewhat the much hyped risks related to the radio applications at these frequencies (5G etc)..

## Keywords

Electronics education, millimeter wave radar, 5G