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Flexible Leaky Wave Antennas for Wearable Radars

G. Sacco*, P. Vadher, and D. Nikolayev
IETR, University of Rennes, UMR CNRS 6164, F-35000 Rennes, France, e-mail: giulia.sacco@cnrs.fr; pratik-vinubhai.vadher@univ-rennes.fr; denys.nikolayev@cnrs.fr

Thanks to their wearability and easiness of use, on-body sensors are increasingly employed for several applications, including healthcare and sport [1]. One emerging application consists in the use of radars as electronic aids for the help of visually impaired people. Thanks to their ability to realize a 2-D map of the environment, radars allow to detect approaching obstacles and help the patients to navigate and understand the surrounding environment. However, these radars are typically included in bulky devices such as white canes, belts or glasses and are realized on entirely rigid substrates. To improve their wearability and portability issue, it is fundamental to replace the current generation of rigid devices with portable flexible sensors that could be easily integrated inside clothes. To allow for sensing the surrounding environment and communicating with other sensors or readers placed on or outside the body, these devices necessitate antennas. To ensure the comfort and the portability, antennas need to be realised on a flexible substrate conformal to the body surface. Previous studies have been reported on the feasibility of single-element resonating antennas [2], and phased arrays [3]. While the first solution does not provide reconfigurability of the radiation pattern, the second requires multiple channels and a complex feeding network to allow for the re-orientation of the beam. As a solution we propose a microstrip-based leaky-wave antenna (LWA), that, thanks to the easiness of fabrication, low cost and, low profile is a valid alternative for wearable applications (Fig. 1). While microstrip LWAs typically operate in the $n = -1$ spatial harmonic [4], in the present work, we discuss a new meandering microstrip design that operates at $n = -2$ resulting in a faster scanning rate (the ratio of beam scanning range and bandwidth). The K-band proposed antenna is based on a periodic meandering microstrip line ensuring a continuous beam scanning from backward-to-forward direction in the elevation plane. The electrical length of the unit cell is increased to make the antenna operate in a higher spatial order which increases the scanning rate. The final design shows a scanning range in the elevation plane from −40° to 45° in the frequency range 20.6−24.6 GHz, which corresponds to a scanning rate of 21.25 ° GHz^{-1} i.e., more than twice the one achievable with a traditional meandered microstrip antenna.

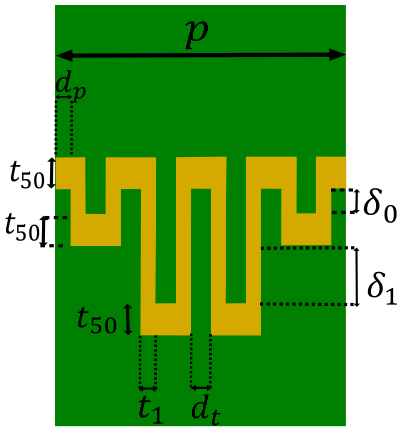

Figure 1. Geometry of the proposed unit cell.

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