Poster: Radar-CA: Radar-Sensing Multiple Access with Collision Avoidance

Yanlong Qiu
Temple University
Philadelphia, USA
Southern University of Science and Technology
Shenzhen, China
tuh34238@temple.edu

Jiaxi Zhang
Southern University of Science and Technology
Shenzhen, China
jzhanghl@connect.ust.hk

Kaiyi Huang
Southern University of Science and Technology
Shenzhen, China
11912211@mail.sustech.edu.cn

Jin Zhang
Shenzhen Key Laboratory of Safety and Security for Next Generation of Industrial Internet, Southern University of Science and Technology
Shenzhen, China
zhangj4@sustech.edu.cn

Bo Ji
Virginia Tech
Blacksburg, VA, USA
boji@vt.edu

ABSTRACT

We propose a practical and efficient radar interference mitigation system, Radar-CA. Radar-CA overcomes the limitations of requiring any additional equipment or resources. Radar-CA transfers the access time estimation problem to a frequency estimation problem, enabling interference mitigation through a central controller, and our preliminary result shows that Radar-CA is capable of mitigating interference efficiently in a dense radar network.

CCS CONCEPTS
• Hardware → Wireless devices; • Computing methodologies → Model development and analysis.

KEYWORDS
Millimeter Wave (mmWave), Interference Mitigation

ACM Reference Format:

1 INTRODUCTION

In recent years, automotive vehicles have gained increasing attention. Automotive radars are crucial components of most automotive vehicles, as they can detect objects at a distance of several hundred feet [2]. Frequency-modulated continuous wave radars (FMCW) are commonly used today.

Automotive radar provides the vehicle with location and velocity information about the surrounding area, allowing the vehicle to act accordingly in a timely and reliable manner. However, radar-to-radar interference can compromise high localization sensitivity and robustness.

Existing works dynamically adjust their own parameters in order to mitigate interference [3]. After adjusting parameters, radars may still be subject to interference, and the parameters will need to be changed again, which is a very time-consuming process. A radar coordination system that is capable of working once and for all is therefore essential for a dense radar network.

As a solution to radar coordination once and for all, we propose Radar-CA, a radar-sensing multiple access system with collision avoidance. Such a system requires that we detect and rearrange the access time for each radar in the network, and inform them of the change. Fig.1 illustrates a Radar-CA scenario in which existing traffic radars are used as a central controller to detect and coordinate radar interference within their detection areas.
is challenging to directly estimate their access times, but we can transmit another known frequency slope $s_c$, radar signal $r_{cc}$. We define the Crossing frequency points as a frequency point that multiple signals sweep to at the same time. When two radar signals sweep to a certain frequency point, it is able to observe a peak in the time domain of the intermediate frequency signal, enabling us to determine their crossing frequency points, and further estimate the access time by $t_i = f_i / s_c$, $i = A$ or $B$. Once the access time is estimated, we can determine whether there exists interference and how to coordinate these radars’ access times.

To inform the change of access time to each radar, we propose an asynchronous carrier frequency modulation scheme as shown in Fig. 2. Specifically, we encode the information on the carrier single frequency, once the target radar receives the signal, it can detect the code by estimating the crossing frequency points. Each adjustment is encoded with its previous access time, and the coordination message is broadcast to all radars. Each radar decodes the coordination message and makes necessary adjustments according to the message, then the interference can be mitigated.

3 PRELIMINARY RESULT

We evaluate the performance of Radar-CA through simulation and experiment. We use three TI AWR1843 radar platforms to evaluate the interference detection rate and the bit-error rate (BER). Then we feed these parameters into a large radar network by simulation. The overall performance is shown in Fig. 3. When there are 100 radars, the radar-to-radar (R2R) interference probability will drop to $10^{-3}%\%$ within seven frame periods (37 ms).

REFERENCES