

# (SD2022-181) R-Fiducial: Reliable and Scalable Radar Fiducials for Smart mmwave Sensing

Tech ID: 33225 / UC Case 2021-Z08-1

## CONTACT

Skip Cynar  
[scynar@ucsd.edu](mailto:scynar@ucsd.edu)  
tel: 858-822-2672.



## OTHER INFORMATION

### KEYWORDS

Human-centered computing,  
  
Ubiquitous and mobile computing,  
  
mm-wavetags, Smart Traffic  
  
Infrastructure

### CATEGORIZED AS

- **Communications**
- Wireless

### RELATED CASES

2021-Z08-1

## BACKGROUND

Millimeter wave sensing has recently attracted a lot of attention given its environmental robust nature. In situations where visual sensors like cameras fail to perform, mmwave radars can be used to achieve reliable performance. However, because of the poor scattering performance and lack of texture in millimeter waves, radars can not be used in several situations that require precise identification of objects.

A video demonstration of R-fiducial could be found at <https://streamable.com/7ax59s>

## TECHNOLOGY DESCRIPTION

Researchers from UC San Diego have invented R-fiducial tags which smartly augment the current infrastructure to enable a myriad of applications with mmwave radars. R-fiducial acts as a fiducials for mmwave sensing and uses a novel spread-spectrum modulation technique that provides low latency with high reliability. Our evaluations show that R-fiducial can be reliably detected with a 100% detection rate upto 25m and upto 120 degrees field of view with a latency of the order of milliseconds.

R-fiducial provides a scalable solution to reliably augment the mmwave sensing infrastructure that is compatible with commercial mmwave radar technology to enable several indoor and outdoor use cases. R-fiducial uses Van-atta array design to enable retro-directivity so that a reader radar can read it from a wide range of angles and provides a framework to design a suitable van-atta architecture. Secondly, R-fiducial distinguishes itself from other objects encountered on roads by creating a unique signature in form of switching frequency. Finally, each R-fiducial is encoded using a specific code, that creates a specific identity for each tag (eg, stop sign, traffic light). Using a code based identification provides scalability required to support multiple tags working simultaneously. With all these features, R-fiducial can be reliably used in applications where visual sensors do not work because of poor visibility.

## APPLICATIONS

Applications where visual sensors do not work because of poor visibility, such as Smart Traffic Infrastructure.

## ADVANTAGES

Robust, Low power, Retro-reflective mm-wavetags for Smart Traffic Infrastructure.

## STATE OF DEVELOPMENT



(a) Fire equipment detection through smoke during fire.

(b) Reliable traffic sign detection in bad weather

**Fig. 1.** R-fiducial enhances the ability of mmwave radars by augmenting the current infrastructure with specialised hardware. (a) Shows a corridor filled with smoke during fire where camera fails to detect fire equipment and exit. (b) Shows a stop sign in foggy weather. In both the cases the presence of R-fiducial tags enables the radar to reliably identify and localizes fire extinguisher and exit in (a) and stop sign in (b).

## INTELLECTUAL PROPERTY INFO

UC San Diego is seeking partners to help commercialize this patent-pending technology.

## RELATED MATERIALS

- Kshitiz Bansal, Manideep Dunna, Sanjeev Anthia Ganesh, Eamon Patamsing, Dinesh Bharadia. 2022. R-fiducial: Reliable and Scalable Radar Fiducials for Smart mmwave Sensing. [arXiv:2209.13109 \[eess.SP\]](https://arxiv.org/abs/2209.13109) - 09/27/2022

**University of California, San Diego**  
**Office of Innovation and Commercialization**  
9500 Gilman Drive, MC 0910, ,  
La Jolla, CA 92093-0910

Tel: 858.534.5815  
[innovation@ucsd.edu](mailto:innovation@ucsd.edu)  
<https://innovation.ucsd.edu>  
Fax: 858.534.7345

© 2023, The Regents of the  
University of California  
[Terms of use](#)  
[Privacy Notice](#)