A Novel Method for RF Field Programming and Intelligent Surface Design Using Diffraction-Inducing Elements

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BACKGROUND

There has been considerable interest in recent years in programming radio frequency (RF) fields, in order to generate any desired radio frequency field pattern over the space. For instance, by generating a strong beam at certain locations or directions in space, one can create a good communication quality for users at those locations. Alternatively, the transmitter may want to minimize the field at certain locations/directions in space where there are no users.

As such, the area of Intelligent Electromagnetic Surfaces, also known as Intelligent Reflective Surfaces (IRS), Metasurfaces, or Reconfigurable Intelligent Surfaces (RIS), has seen a drastic growth over the past few years. Such two-dimensional arrays of unit elements with sub-wavelength dimensions are envisioned to smartly control, manipulate, and program the incident electromagnetic field in any desired manner. However, most current work utilizes complex and costly unit element design, relying on specialized RF components to achieve focusing.

DESCRIPTION

Researchers at the University of California, Santa Barbara have proposed a novel method for programming RF fields and multi-focus beamforming by exploiting the phenomenon of diffraction. They propose a new intelligent surface design: a lattice of diffraction-inducing elements such as edge elements. This can provide a rich repertoire for programming the RF field, by exploiting diffraction phenomena. Specifically, by using off-the-shelf edge element units, desired RF fields can be achieved with minimal cost, as compared to existing complex and specialized designs. For instance, a prototype was built using inexpensive thin steel plates as the lattice elements, which were sourced from a local hardware store. This technology can play a key role as part of next generation cellular systems or smart home systems.

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ADVANTAGES

- Proposes a new cost-effective lattice element design
- Does not require specialized element design
- Can program the RF field
- Can generate multi-beam focusing

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OTHER INFORMATION

KEYWORDS

RF signals, radio frequency, wifi, RF fields, smart homes, routers, sensing, sensors, wireless, imaging, mmwaves

CATEGORIZED AS

- **Communications**
  - Other
  - Wireless

RELATED CASES

2024-861-0, 2025-353-0, 2025-337-0

- Methods have been tested in real-world environments

APPLICATIONS

- Smart homes
- Next generation cellular systems
- Smart routers
- RF sensing applications

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Published Application	20250123391	04/17/2025	2024-861

Additional Patents Pending

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- RF Signal-Based Human Context Inference for Health and Safety Monitoring
- Sensing with RF Signals by Exploiting Diffraction
- Generating Massive Synthetic RF Data for RF Sensing Applications
- RF Signals for Crowd Analytics and Collective Behavior

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