

# Electronically-Reconfigurable Surfaces for Improved Coexistence Between Radio Astronomy and Satellite Communications Systems

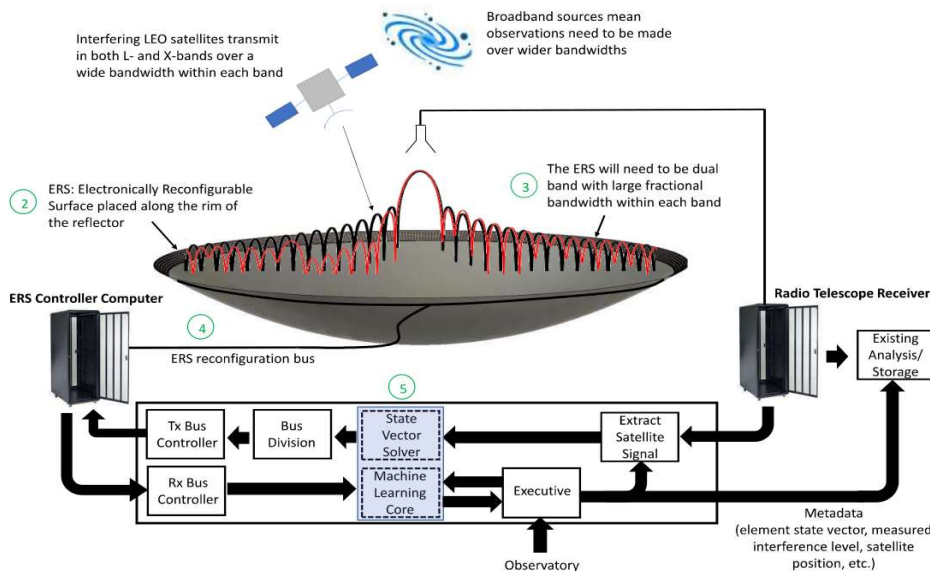


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 May 3, 2024



This work supported by  
 AST-2128506

## Dynamic Pattern Control Using Rim-Mounted Surfaces



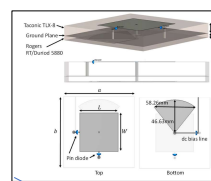
## Background

Radio astronomy is impacted by emerging low-Earth orbiting satellite megaconstellations



Video: "Techniques for Observing in the Presence of Satellite Interference"

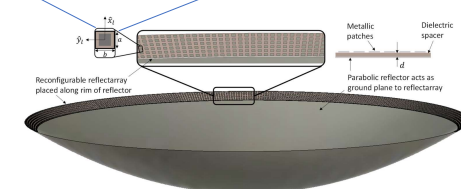
## Electromagnetic Design



Leveraging modern methods in reflectarray design & analysis

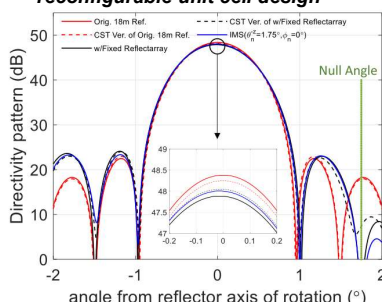
Full-wave EM simulations confirm negligible impact on aperture efficiency or system temperature

Budhu et al. (2024), *IEEE Trans. Ant. & Prop.*



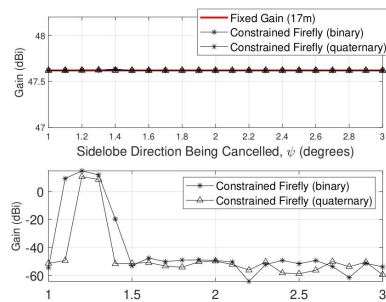
## Results

### New full-wave EM analysis & demonstration with implementable reconfigurable unit cell design



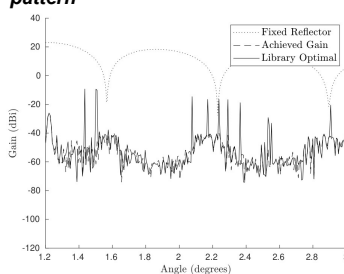
Budhu, Hum, Ellingson & Buehrer (2024), *IEEE Trans. Ant. & Prop.*

### Fast optimization of null depth while preventing "rumbling" main lobe gain

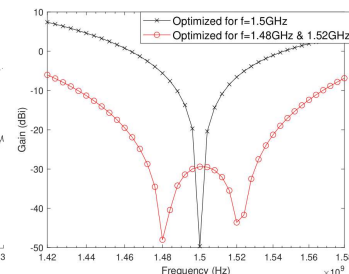


Howard, Buehrer & Ellingson, arXiv:2308.16339 (Feb 2024)

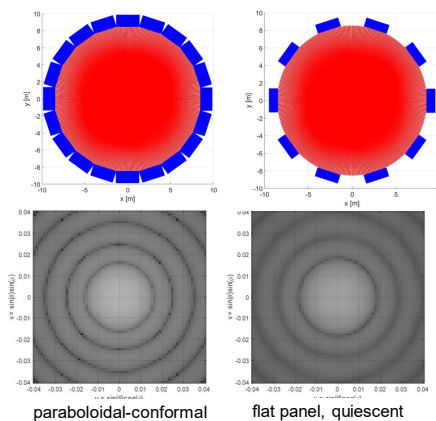
### Tracking + closed loop optimization to accommodate uncertainty in quiescent pattern



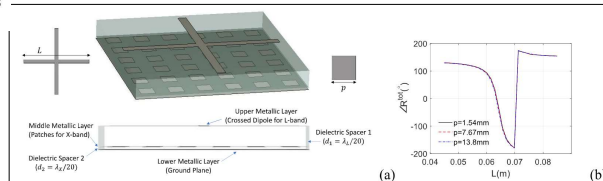
### Increasing bandwidth using only element state configuration



## Flat-Panel "Outrigger" Implementation



These surfaces can be implemented as flat panels added to existing reflector systems. Surfaces need not be conformal or continuous in any particular way. Incomplete aperture merely limits minimum angle from main lobe for effective nulling.



## Works in Progress

- Subreflector implementation
- Analysis of systematics introduced into radio astronomical observations; e.g., cross-polarization, artifacts from null tracking
- Network-level implications:** How can this actually be used to manage coexistence between satellite constellations and radio telescopes?
- Additional speed-up of computation; e.g., element state "chunking"
- Single-panel reflectarray nulling demonstration (U. Toronto)

## More Information



Project updates, publications, videos, education & outreach:  
 VT Radio Astronomy Interference Mitigation Project Web Site  
<https://ellingsontvt.info/raim/>