REMCOM®

Electromagnetic Simulation Software

RF Wireless System Digital Twins and Automation for AI

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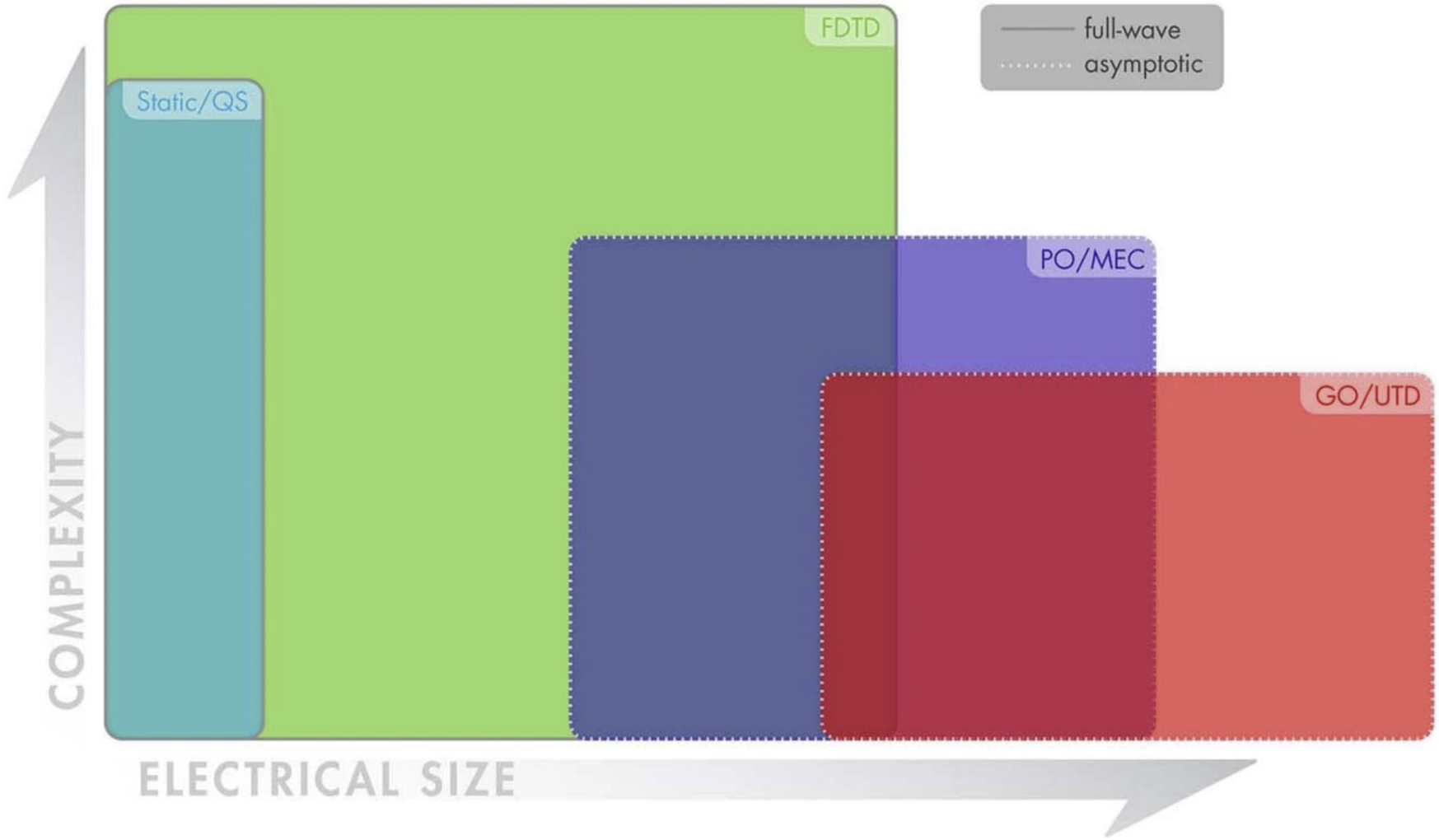
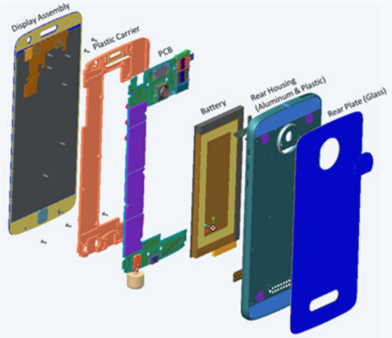
Computational EM Complexity vs Size

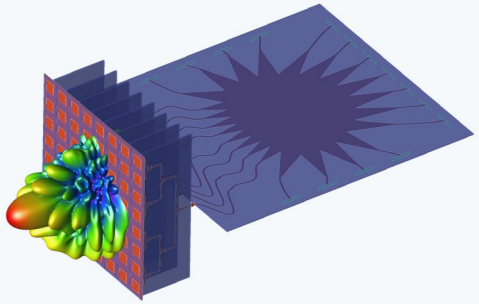


3D Simulation Platform

XFdtd®

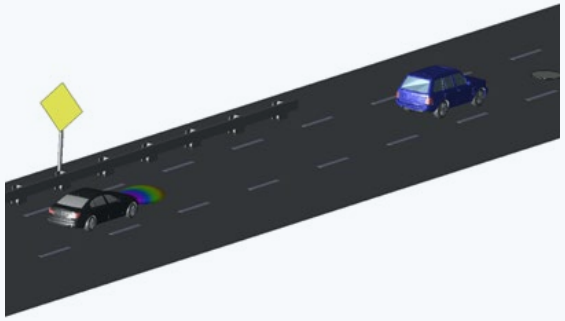
EM GPU FDTD:
Antennas, RF, Bio, RCS
Photonics

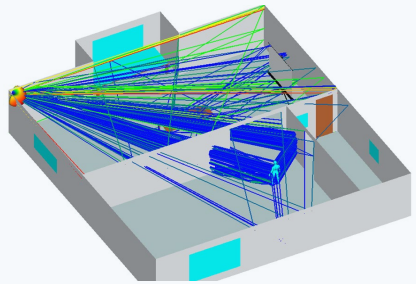




WaveFarer®

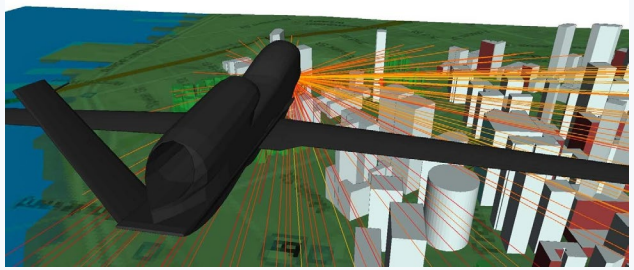
EM GPU Ray Casting:
Mobile Sensing
Scenarios for Radar/RCS

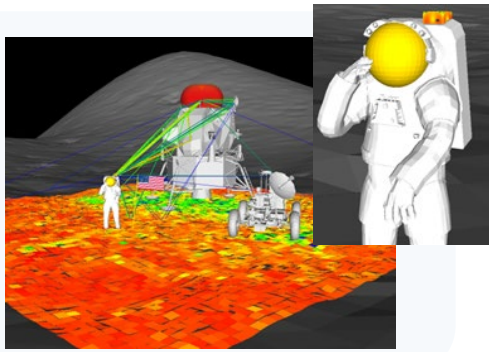




Wireless InSite®

EM GPU Ray Tracing:
Mobile platforms for
wideband channel
modeling

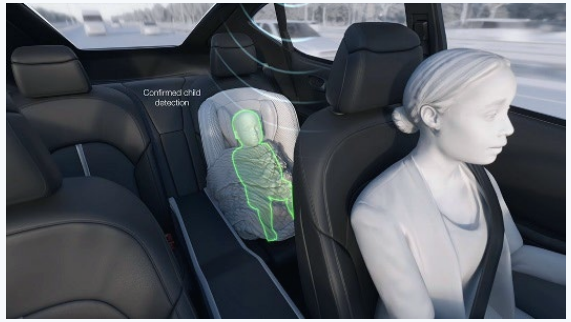




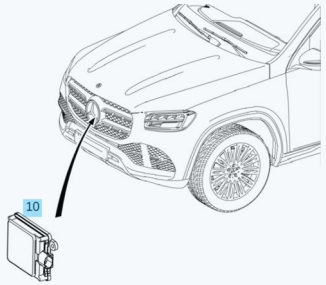
REMCOM®

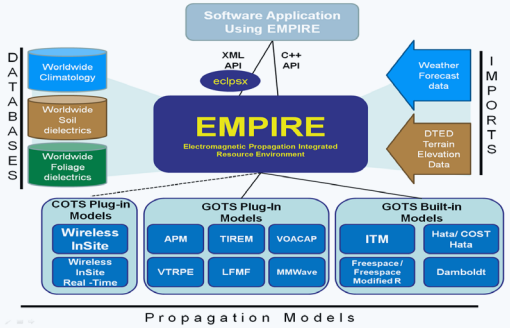
Markets

Consumer Electronics



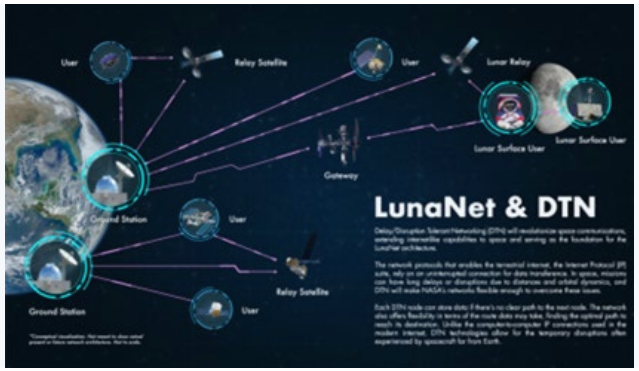
Automotive





DoD/Space

DEVCOM ARMY RESEARCH LABORATORY



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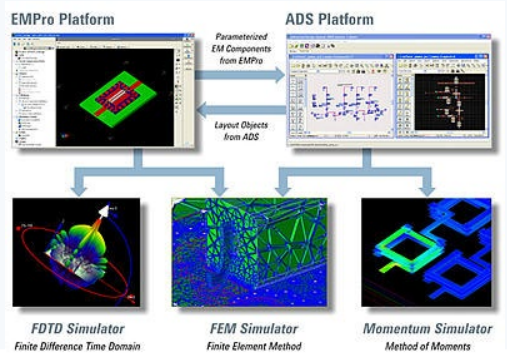
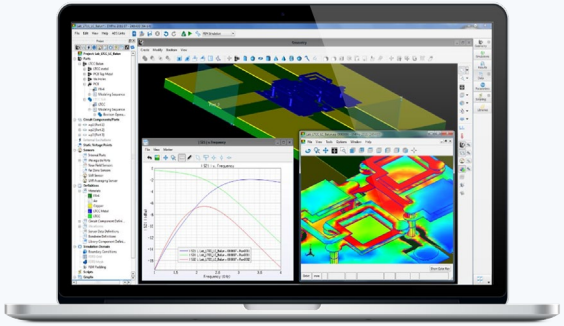
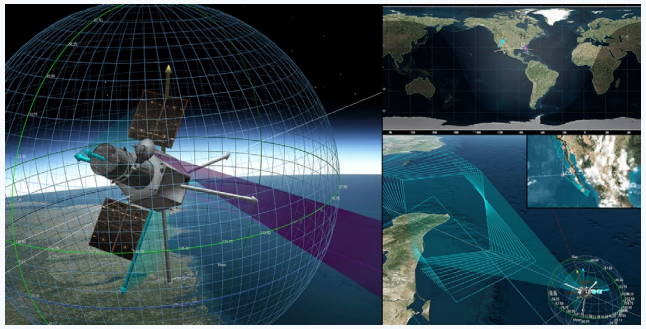
Partners



Keysight EDA

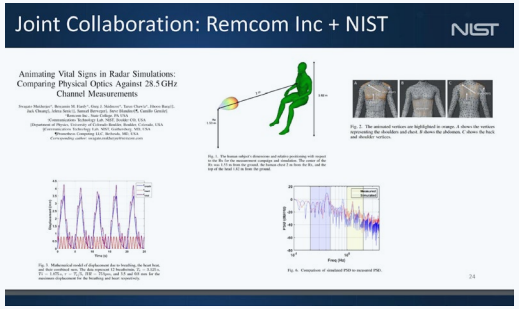
Ansys AGI STK





OTA Hardware

Emulation



API Integrators

PHY Layer Datasets

Ansys
GOVERNMENT INITIATIVES (AGI)

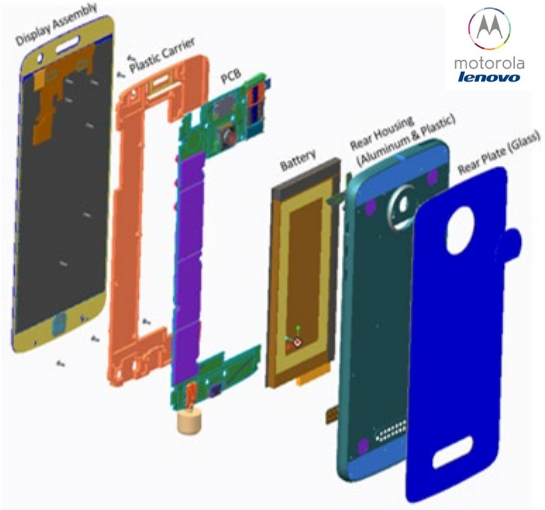
DeepMIMO

DeepVerse 6G
A Digital Twin Dataset for Wireless Communication and Sensing

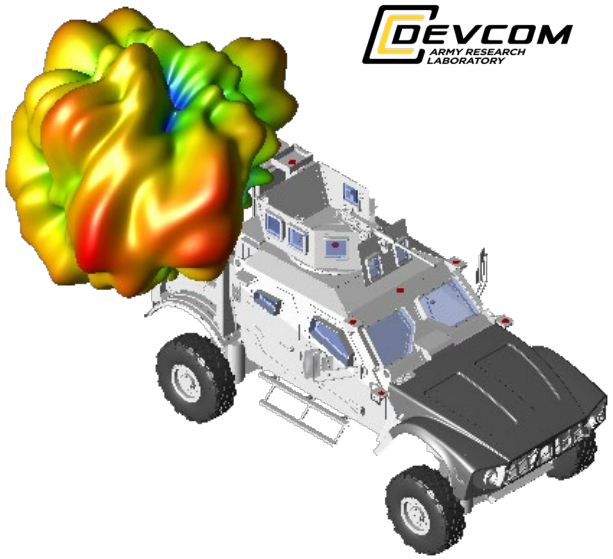
REMCOM

CAD for Manufacturing and Testing

ECAD



MCAD



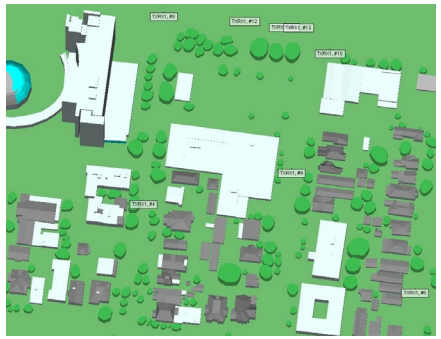
Voxel/Tissue

REMCOM

Digital Twin Datasets

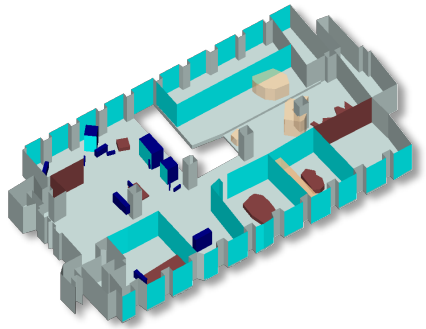
Datasets

Outdoor



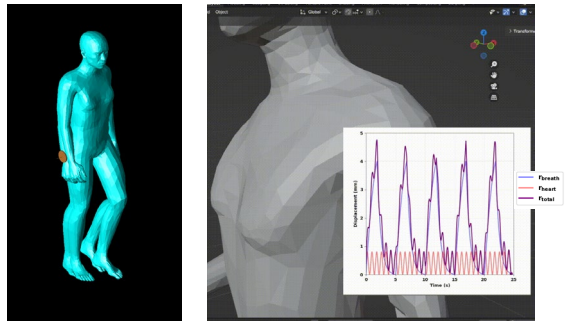
Terrain, Buildings, Foliage

Indoor



Floor, Ceiling, Objects

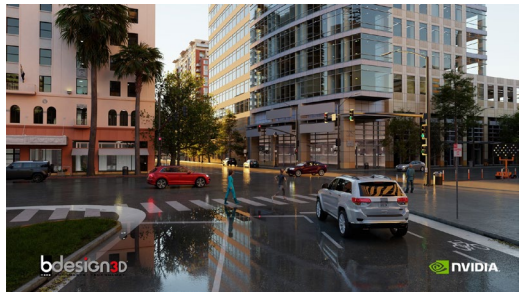
Humans



Breathing with Heartrate

Processing Tools

OpenUSD blender



OPEN BIM™ IFC

FreeCAD

blender

blender

NVIDIA OMNIVERSE USD

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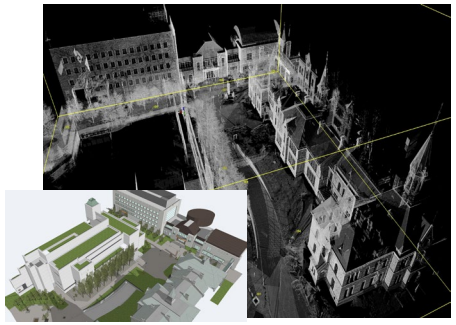
Digital Twin Capture Methods

Outdoor

LiDAR/Camera



Terrain, Buildings, Foliage

Indoor

Floor, Ceiling, Objects

Humans

Face, Arms, Joints, Legs

Data Acquisition

USGS science for a changing world

EarthExplorer

Open Street Map

FAO FIAT PANIS

AIRBUS

Community, Land, Soil

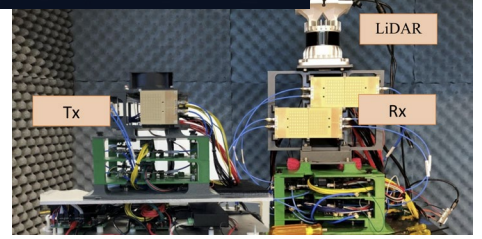
構造計画研究所 KOZO KEIKAKU ENGINEERING Inc.

NAVVIS IVION

Artec 3D

Innovation, Science and Economic Development Canada

NIST COMMUNICATIONS TECHNOLOGY LABORATORY



MOVESENSE

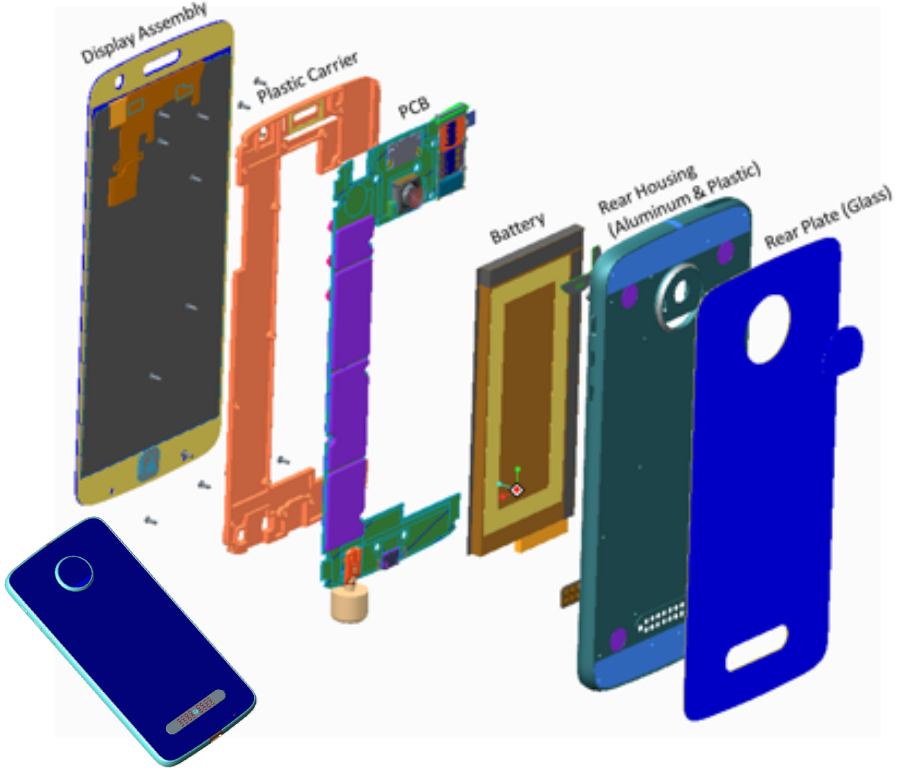
ECG, Heart Rate

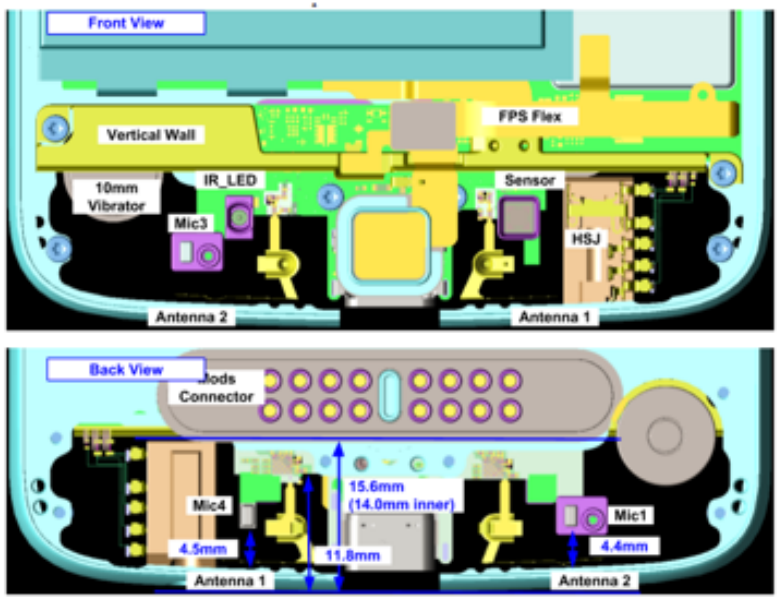
REMCOM

Simulation Validation

Motorola Phone – Nearfield Correlation

Full mechanical model (>1000 parts) with full PCB





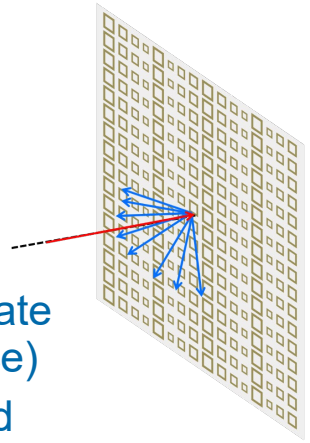
Frequency Band	Delta TIS (dBm)
B2 (1900 MHz)	0.72
B4 (1710 MHz)	-0.32
B5 (824 MHz)	1.7
B13 (777 MHz)	1.42

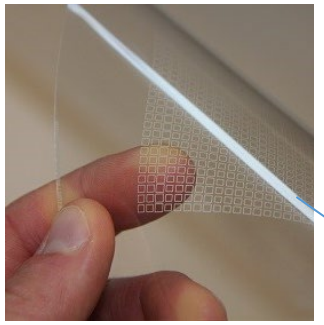
Images provided Courtesy of Motorola Mobility LLC, a wholly owned subsidiary of Lenovo

Metamaterial - Indoor mmWave Multipath

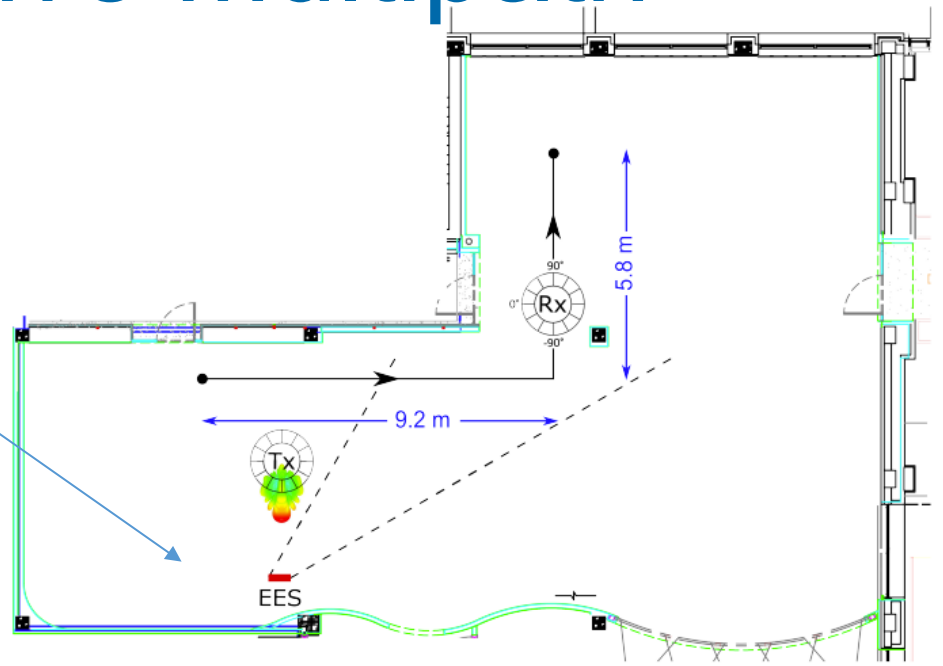
Compares CRC Theory & Measurements to Wireless InSite prediction in an indoor office environment

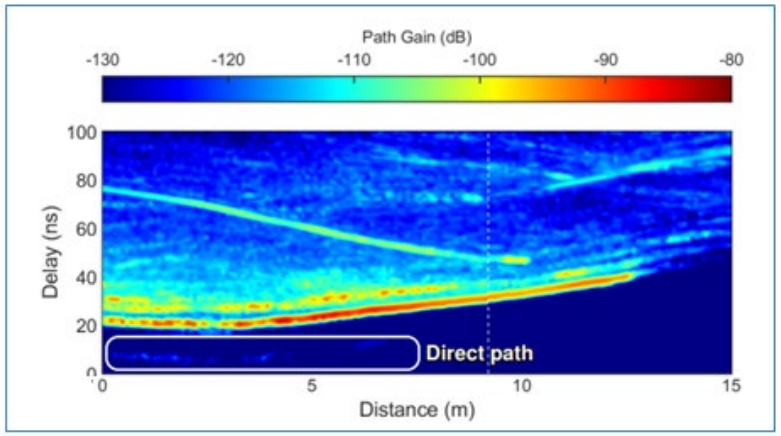
- Tx directed at an Diffuser plate (30-60 deg, normal incidence)
- Rx route, in LOS and around corner

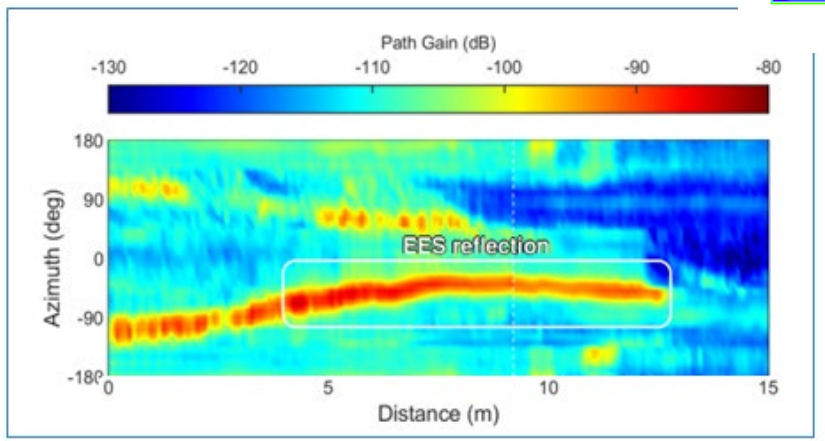




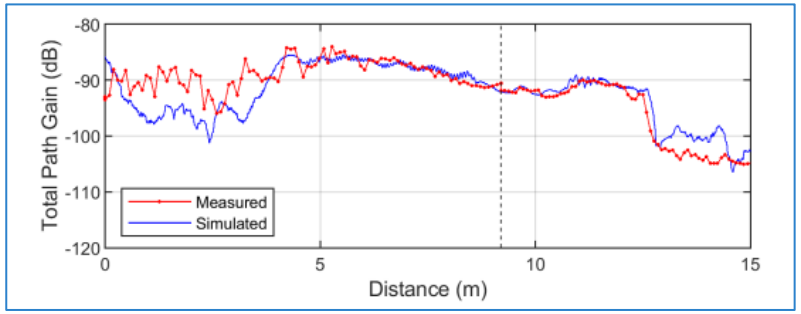
Diffuser







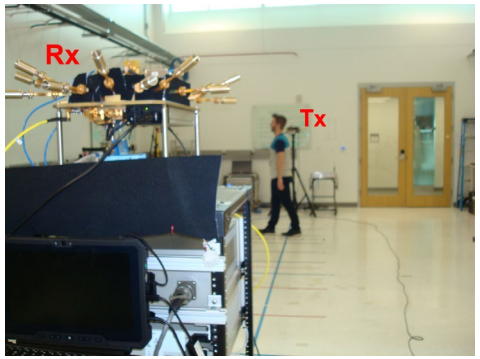
Measured multipath gain distributions versus distance along the Rx



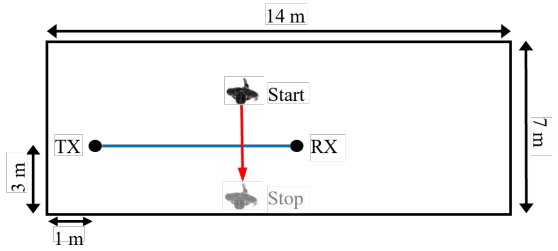
Total path gain: measured vs. Wireless InSite

Human Shadowing - Correlation

Measurement Campaign

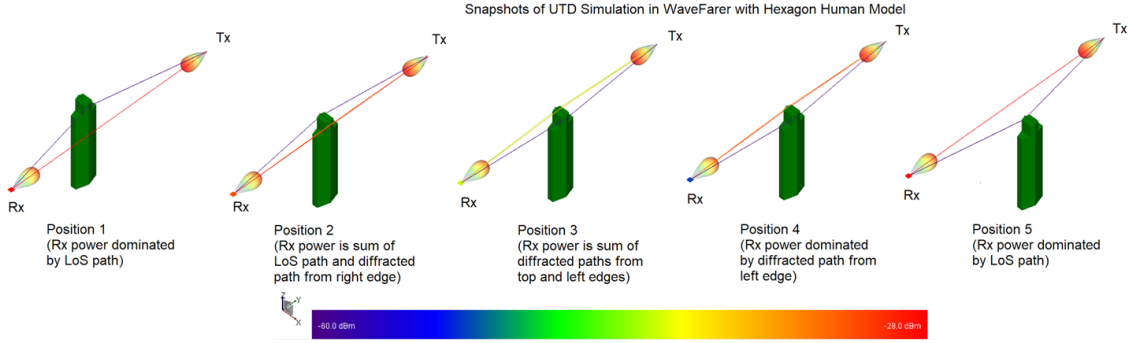


Varied Tx-Rx separation and position of person

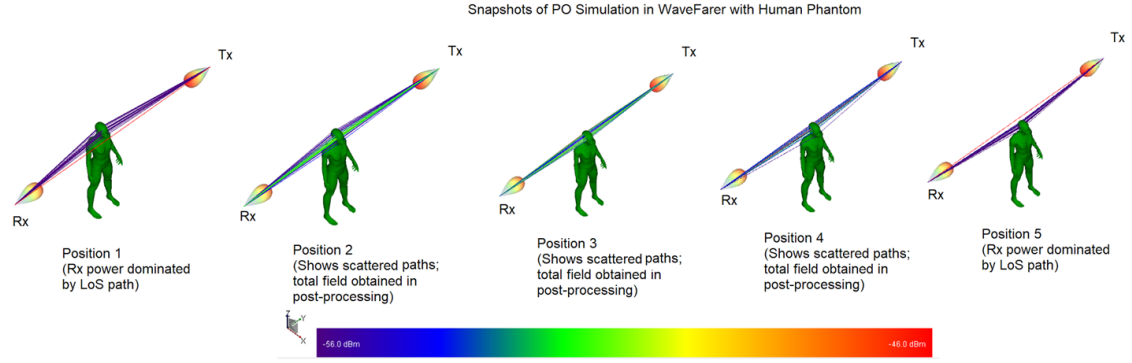


Ray Diagram of UTD and PO simulations in WaveFarer for certain positions of the human model

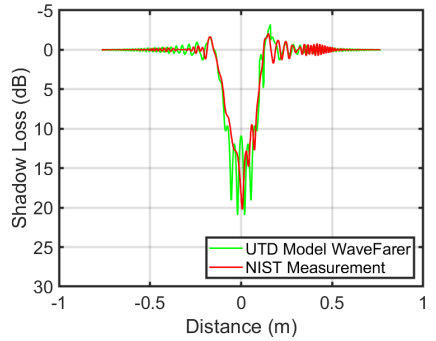
Using UTD

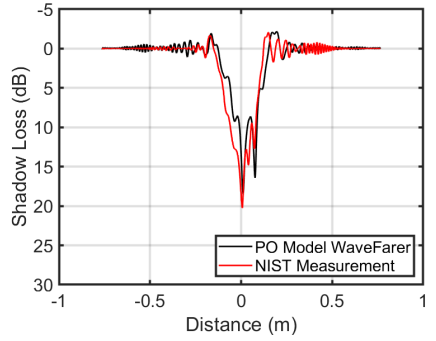


Using PO



Validation Examples



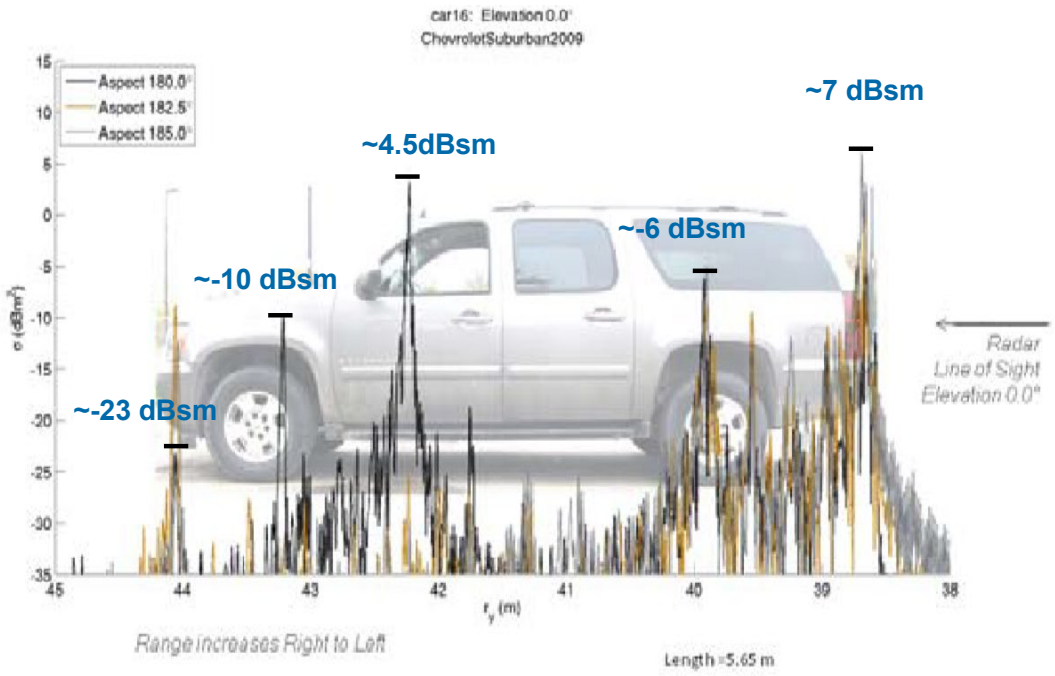


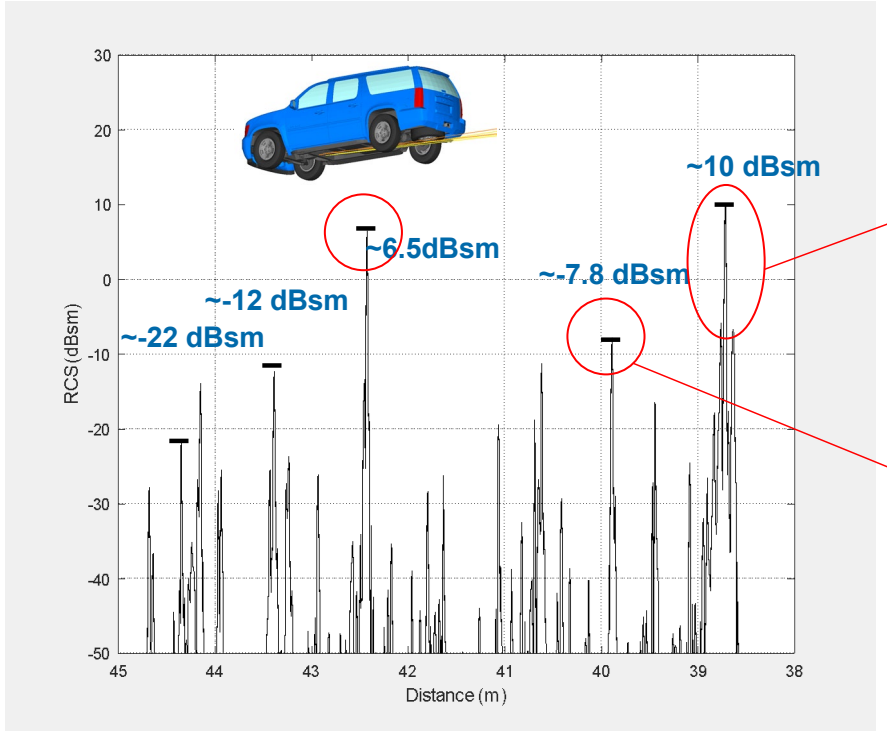
S. Mukherjee, G. Skidmore, T. Chawla, A. Bhardwaj, C. Gentile and J. Senic, "Scalable Modeling of Human Blockage at Millimeter-Wave: A Comparative Analysis of Knife-Edge Diffraction, the Uniform Theory of Diffraction, and Physical Optics Against 60 GHz Channel Measurements," in *IEEE Access*, vol. 10, pp. 133643-133654, 2022, doi: 10.1109/ACCESS.2022.3231812.

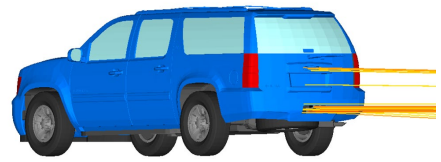
Automotive NHTSA Measurements

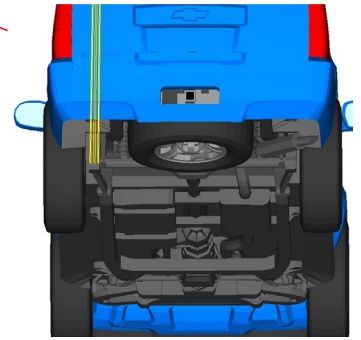
Compared high-range resolution (complex impulse response) RCS

- 94 GHz with 8 GHz bandwidth





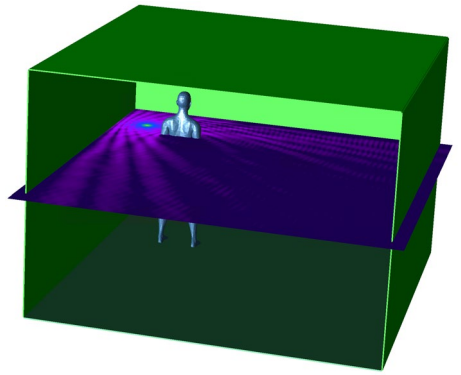


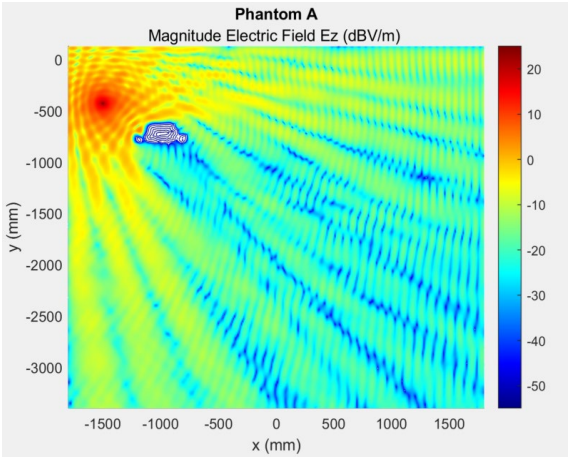


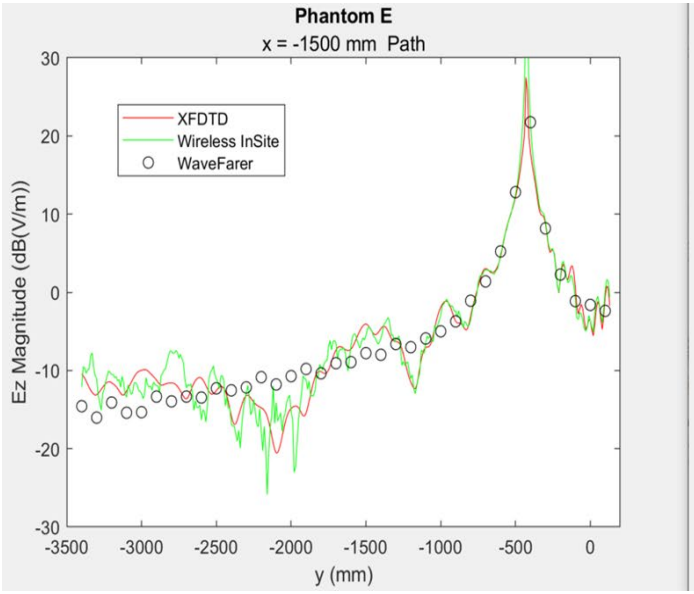
1. Buller, W., et al., "Radar Measurements of NHTSA's Surrogate Vehicle SS_V," National Highway Traffic Safety Administration (NHTSA), U.S. Dept. of Transportation Report DOT HS 811 817, August 2013.

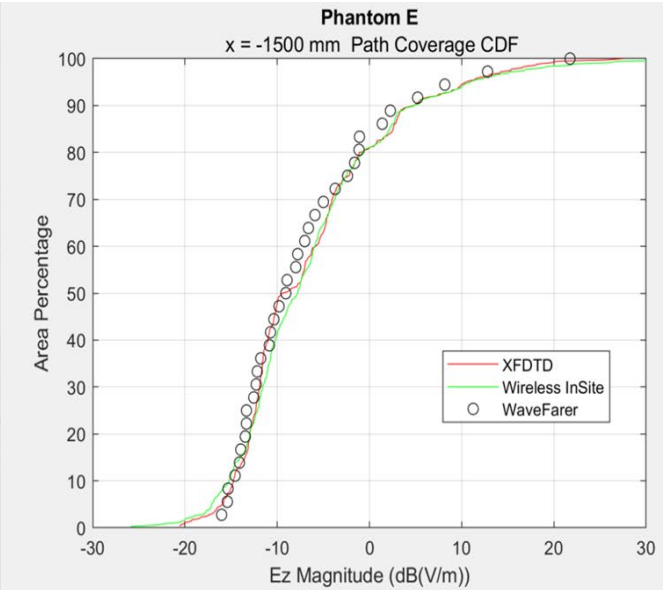
Full-Wave vs Asymptotic Methods

- Simulated a salt-water man in a room with a vertically polarized antenna
- Compared ray tracing methods full-wave
  - Full-wave: FDTD (XFdtd)
  - Ray-tracing: Physical Optics (WaveFarer) and the Uniform Theory of Diffraction (Wireless InSite)
- Result
  - Field magnitudes and CDF show excellent agreement with full-wave solution









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Machine Learning Optimization

3D Antenna Design using Genetic Algorithm

3D antenna generation by JPL, Ohio State and Remcom

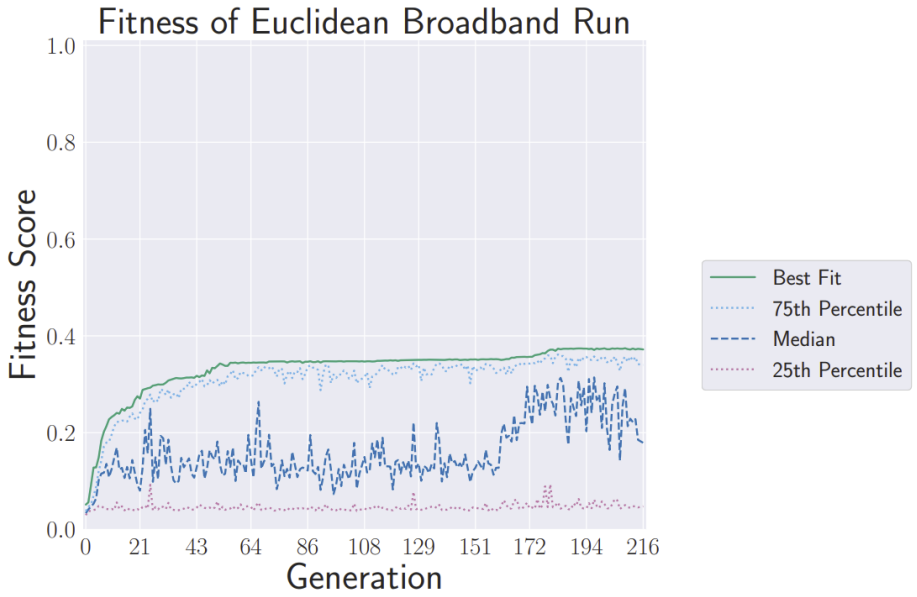
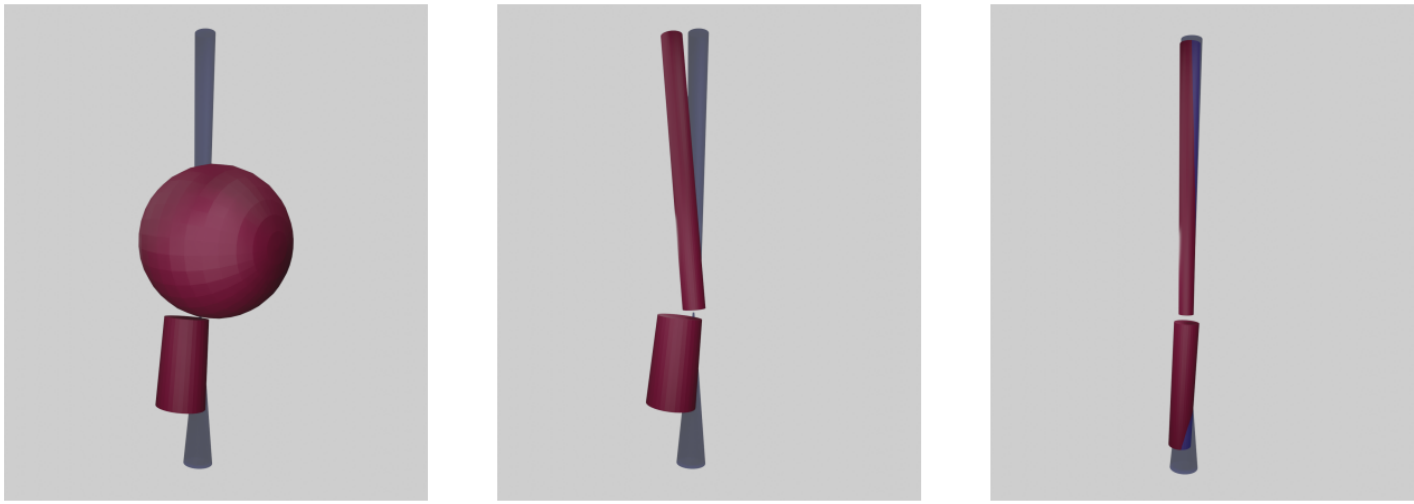


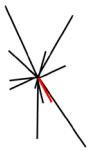
Figure 7. The fitness score of each generation evolving toward a target broadband radiation pattern using the Euclidean distance fitness function. The maximum fitness score and the three quartiles are shown.

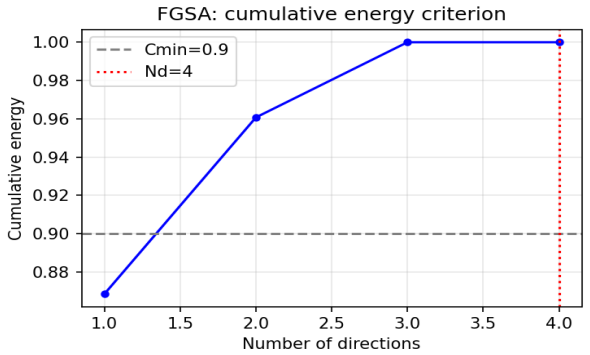


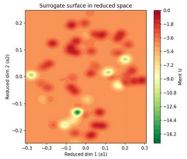
(a) Generation 0 (b) Generation 5 (c) Generation 216

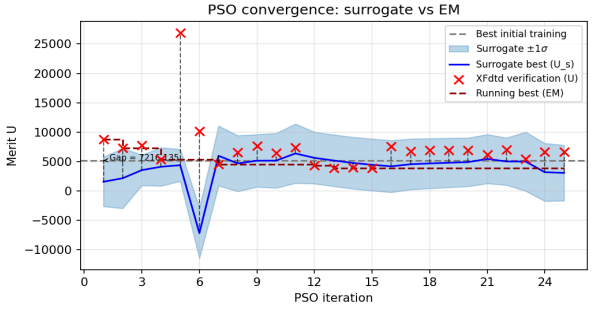
Figure 8. Three example models of the best individuals from generations 0, 5, and 216 are shown, illustrating the evolution of broadband antenna using the Euclidean distance fitness function. The antenna that produced the target gain pattern is given in blue, and the individual is shown in red.

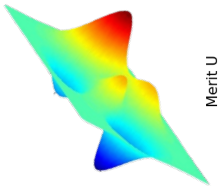
3D Geometric ML Surrogate Optimization

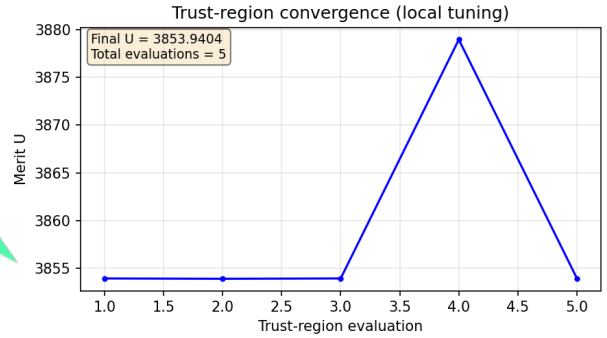


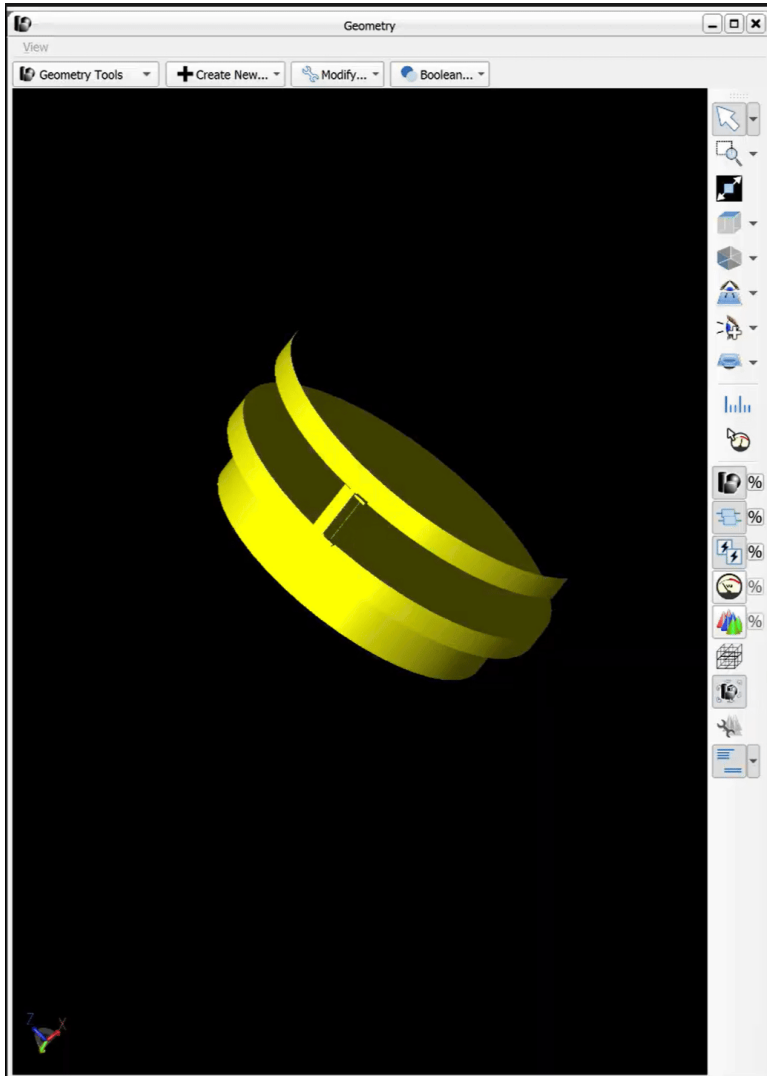


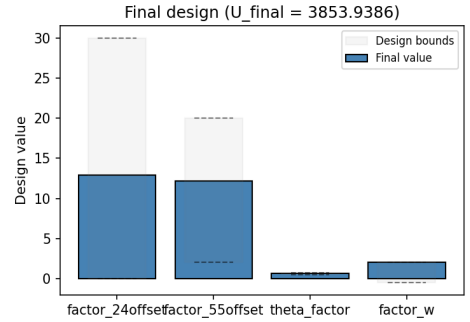


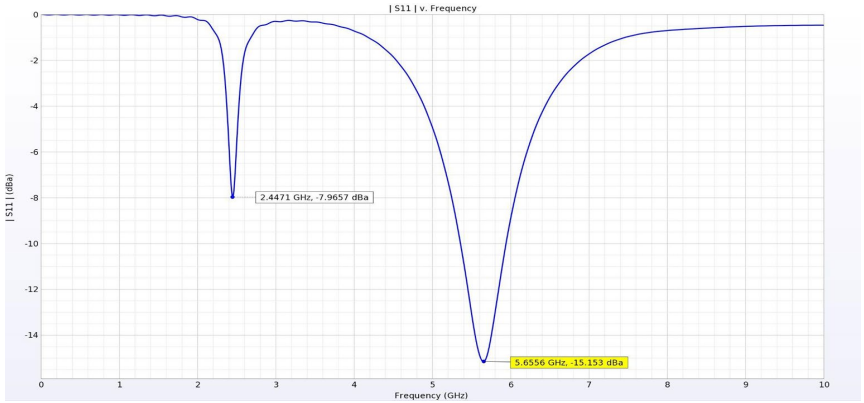








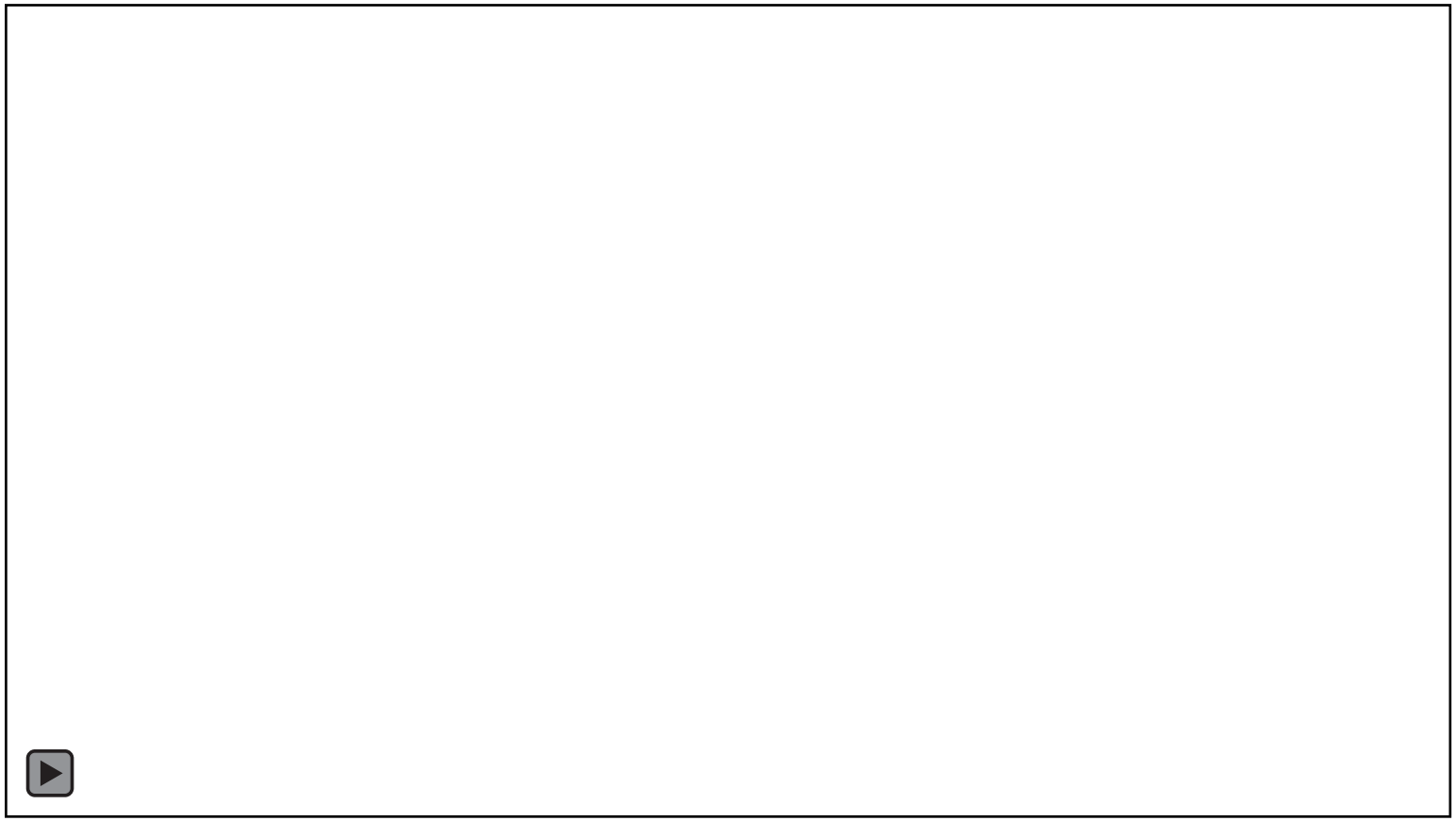




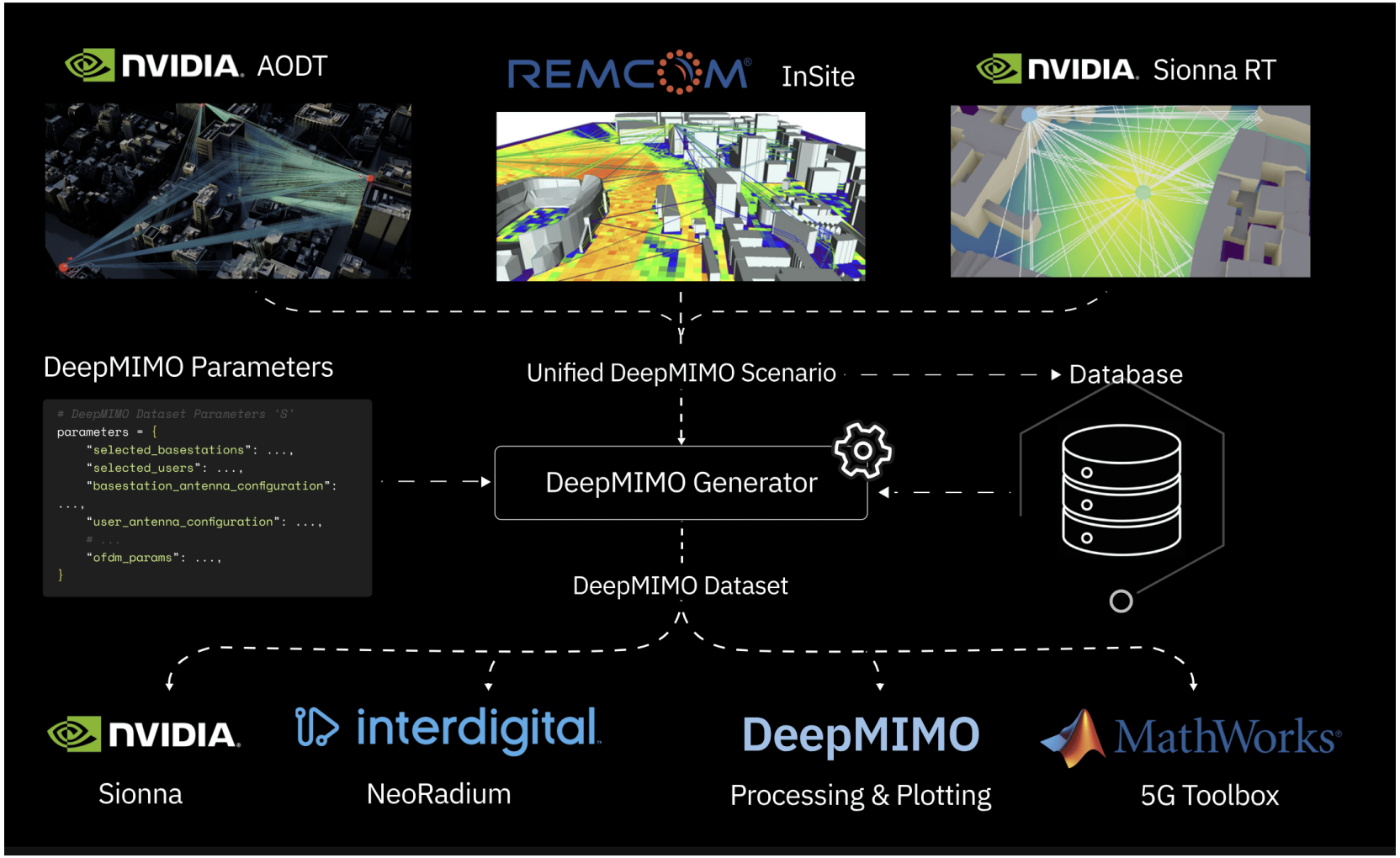
Cost: 160 sims vs 400+ PSO

AI Integrated Sensing and Comms Demo

TUM built an indoor chatbot controlled MMSF data builder. RF data pretrained using Remcom tools



DeepMIMO: The Standard for Ray-tracing Datasets in Wireless

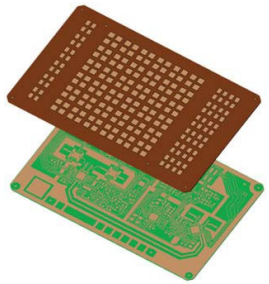


AI Agents – Remcom Fusion Studio

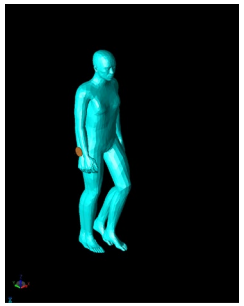
Remcom - Fusion API

Claude

Full Device



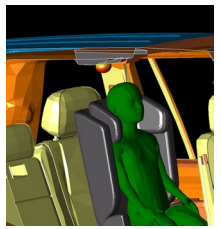
Radar placement
in car

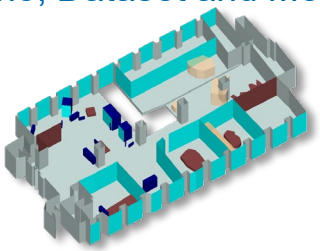


Smartwatch
Walking Indoor

Anatomically accurate, reliable, reproducible
movement and vital signatures

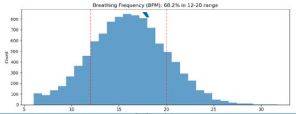
Map to Scenario, Dataset and Measurements





DeepMIMO

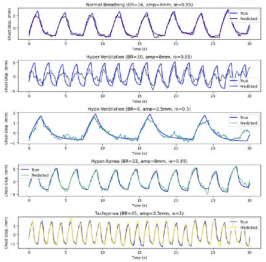
Generate Rx power, CIR, IQ



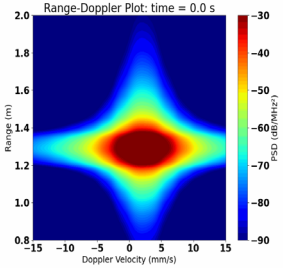
Post-Process

Channel Emulation

Machine Learning

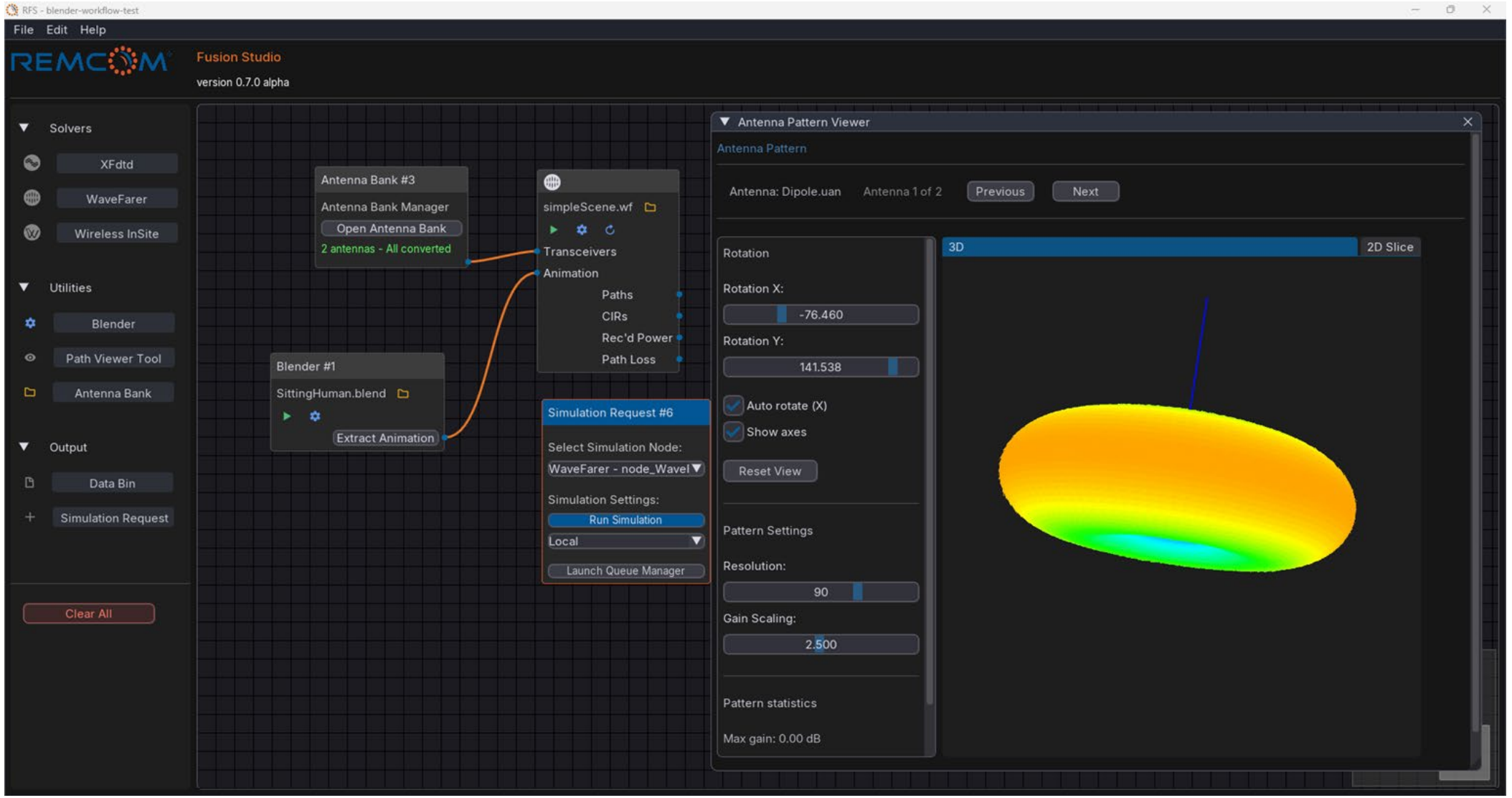


Range Doppler

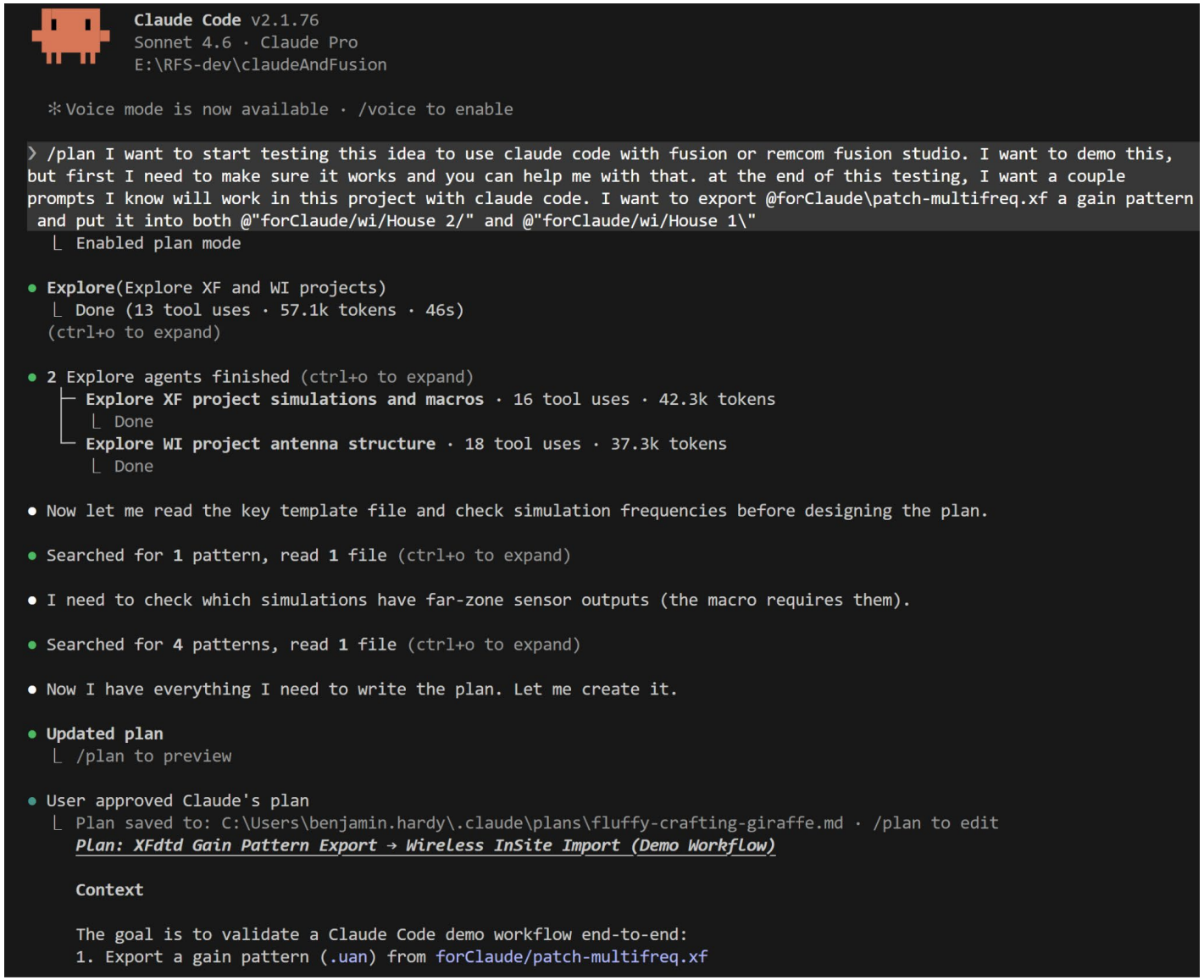


REMCOM

Remcom Fusion Studio - Agentic Orchestration



Remcom Fusion Studio – Claude mode



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