Pattern Synthesis and Antenna Receiver Design

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Project Overview

This project's focus is an investigation into various methods of radiation pattern synthesis and antenna receiver design and development for application in a multistatic passive radar system using third party transmitters (UHF TV and FM radio signals).

Key Objectives:

- Map the immediate EM environment
  - Use transmitter data provided by Sentech and AREPS (Fig 1) [1]

- Investigate methods radiation pattern synthesis
  - esp. Beamforming and Null Placement

- Design, build and test receiver system
  - Using FEKO (Fig 3) [2] extensively in the design phase

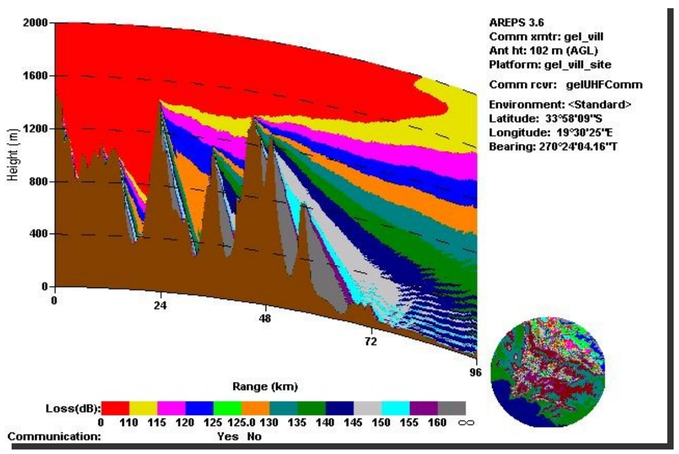

Fig 1: Propagation loss calculated using AREPS of a TV signal emitted from a Viliersdorp transmitter

Brief system overview (Fig 2): The receiver antenna array will detect reflections off targets using signals of transmitter 1 while suppressing the direct signal (null 1). At the same time the direct reference signal from transmitter 1 will be required through a second channel (reference antenna) for signal processing purposes.

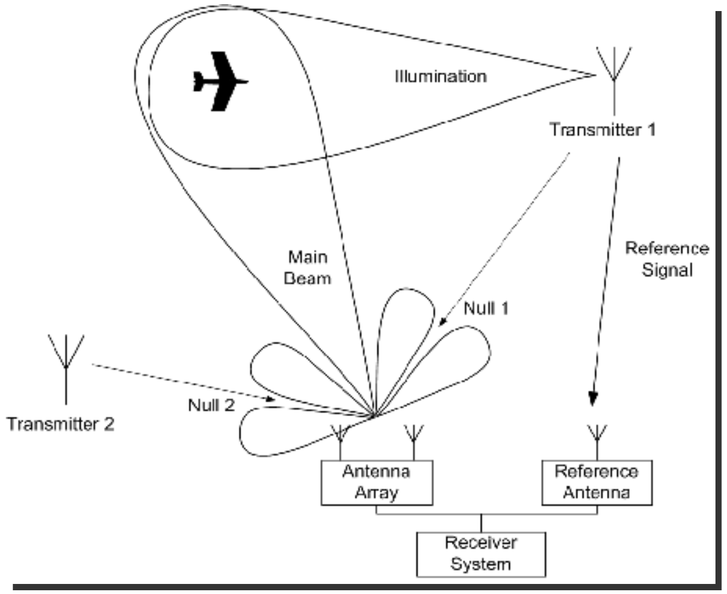

Fig 2: Receiver system overview illustrated in the azimuth plane

Mapping the EM environment

An investigation into the surrounding transmitters will be required so as to locate an ideal transmitter of opportunity and determine possible sources of interference.

Physical measurements taken from the roof and the EM propagation simulation tool AREPS will provide the means to achieve this. An example of AREPS is shown in Fig 1 which illustrates the propogation loss of a transmitted signal.

Radiation pattern synthesis

Beamforming is required to ensure maximum gain in the direction of the signal of interest (SOI), while the effective placement of nulls is also an essential requirement to suppress inteference. This can be achieved by:

- Choosing individual elements that provide favourable characteristics in terms of input impedance, VSWR, bandwidth etc.

- Applying non-uniform amplitude distributions to the array of elements.

Design, build and test receiver

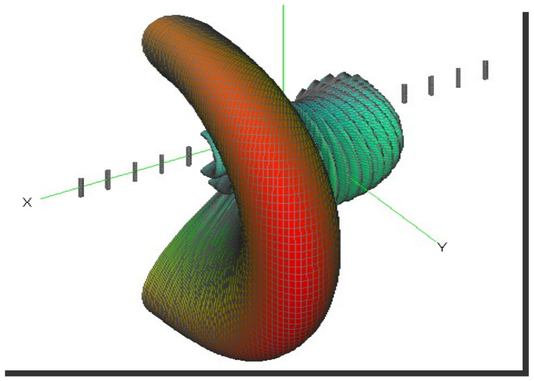

Fig 3: Radiation pattern of a 16 element dipole array employing a Taylor distribution simulated using FEKO.

After designing and simulating the system fully within FEKO - a powerful antenna and EM modeling program - the project will then proceed to the building and testing phase.

[1] http://areps.spawar.navy.mil/
[2] http://www.feko.info/

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