Research Area: Antennas and Scattering

Conformal Array Pattern Synthesis

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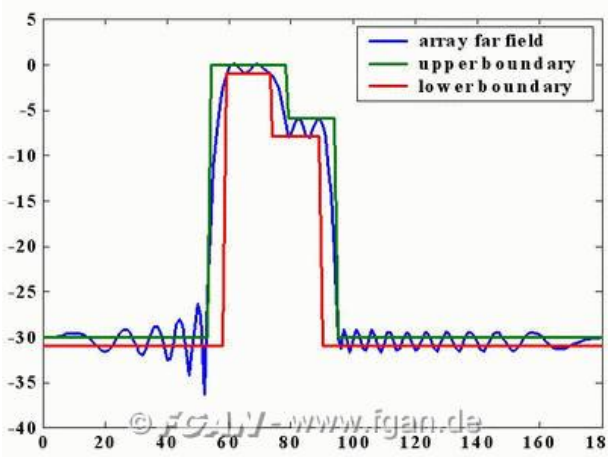
Motivation and Background



Optimization using genetic algorithms (step pattern)

Conformal antenna arrays on curved surfaces will be of high importance for future communication and radar systems - especially on moving platforms and with electronic scanning - because of various advantages over conventional planar arrays, e.g. large field of view and aerodynamic optimization.

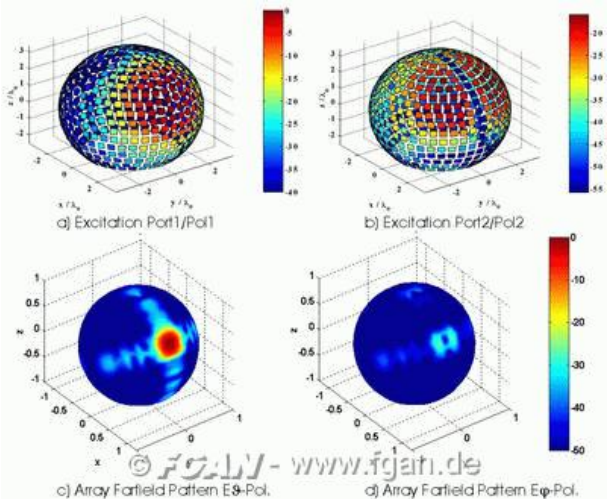
In addition to design and manufacturing, the development of suitable pattern synthesis methods for the various radar applications represents a great challenge because methods proven and tested on linear and planar antenna arrays (separation of element pattern and array factor) can only be applied to conformal arrays with a low degree of curvature - and only with restrictions.

Objectives of Project

The investigation of methods for control of array patterns for various antenna geometries and radar modes as well as the acquisition of a related technical expertise are the primary goals.
Different pattern synthesis methods have been developed in the past. These have proven their suitability to conformal antenna arrays in numerical and experimental investigations. Among these methods are

- mathematical optimization methods (e.g. "Least Mean Square" method, evolutionary algorithms, see Fig.)
- projection methods based on Eigensolutions of Maxwell´s equations [1]
- adaptive methods for interference suppression [2]

Methods and Applications



Spherical antenna array consisting of more than 500 elements

The methods have been evaluated and improved concerning criteria such as super-resolution, adaptive interference suppression and stability. Depending on the requirements and influence of system inherent constraints (e.g. mutual coupling between elements, bandwidth, subarray structures) different methods may be better suited.

Another aspect of work is the influence of static deformations and vibrations caused for example by flight turbulences on the performance of an antenna array and applicable compensation methods within the framework of a recently initiated NATO Research Task Group [3].

In addition, provisions for system constraints such as quantization of element excitation coefficients, subarray structure, bandwidth etc. into pattern synthesis have been investigated.

Literature

[1] P. Knott, "Antennenmodellierung mit Diagrammsynthese zur Systemanalyse von konformen Gruppenantennen", Fakultät für Elektrotechnik und Informationstechnologie, Dissertation, RWTH Aachen, 2002

[2] P. Knott, "Adaptive Beamforming for Conformal Antenna Arrays", European Workshop on Conformal Antenna Arrays (EWCA), Bonn, 2003

[3] H. Schippers, J. H. van Tongeren, P. Knott, T. Deloues, P. Lacomme, M. R. Scherbarth, "Vibrating antennas and compensation techniques - Research in NATO/RTO/SET-087/RTG 50", IEEE Aerospace Conference, 2007

Projects in the field of:
Antennas and Scattering

- Conformal Antenna Array for ERAKO
- Conformal Array Pattern Synthesis
- Fast Integral Methods

- Hybrid Methods
- Metamaterials
- Numerical Simulation of Scattered Fields
- Planar-3D-Simulation
- Scattering of Aerial Vehicles

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