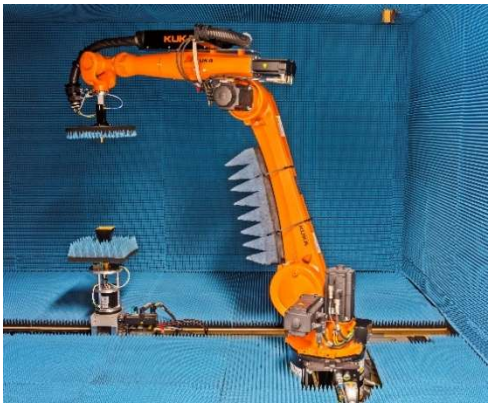
Truncation Error Mitigation for Robotic Near-Field Antenna Measurements

Master Thesis

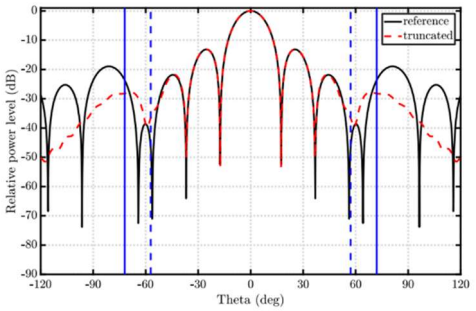
Motivation:

Near-field measurements are a widely used method for antenna characterization. In this approach, the electromagnetic field radiated by the antenna under test (AUT) is sampled on a surface in close proximity to the antenna. Since performance metrics are typically related to the far-field region, a mathematical transformation is applied to the measured near-field data to reconstruct the far-field radiation pattern.



Robotic antenna measurement chamber at IHF

Traditionally, sampling points are distributed on planar, cylindrical, or spherical surfaces located in front of or enclosing the antenna under test (AUT). These canonical geometries were adopted because they enable efficient transformation methods and can be realized using relatively simple mechanical positioners. Recent advances in computational capabilities, together with the introduction of robot-based positioners, have relaxed these constraints and enabled more flexible and optimized sampling strategies.



Far-field radiation pattern with truncation error

Among these established techniques, spherical near-field measurements are the only approach in which the antenna under test (AUT) is fully enclosed by the measurement surface. Although planar and cylindrical near-field measurements are mechanically simpler, they suffer from so-called truncation errors, which significantly limit the valid angular region of the resulting far-field radiation pattern. While robotic positioners are generally not constrained to predefined measurement surfaces, their mechanical configuration typically prevents scans that fully enclose the AUT. Nevertheless, their high degree of mechanical flexibility enables the design of novel sampling grids, which may be exploited to mitigate truncation errors.

Tasks:

- Conduct a literature review on truncation errors in near-field antenna measurements.
- Analyze and implement suitable post-processing techniques for truncation error mitigation.
- Investigate novel sampling surfaces for robotic antenna measurement systems using MATLAB simulations, with the aim of extending the valid far-field region.
- Validate the proposed sampling surfaces through measurements performed with the robotic antenna measurement system at IHF.

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