# Synthesis Techniques for Antenna Arrays (Part 4) – 'Conventional' Synthesis Methods for Uniformly-Spaced Linear Arrays (USLA)

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**Abstract**

Antenna arrays are key technologies enabling a large number of applications within Electromagnetics Engineering including satellite and ground wireless communications, radar, remote sensing, biomedical imaging, and radio-astronomy. For instance, arrays with large "synthetic" apertures are exploited in Synthetic Aperture Radar (SAR) applications for increasing the resolution and improving the quality of the acquired data by means of suitable beam-forming synthesis techniques. On the other hand, the design of high-resolution probing source is a key-issue in NDE/NDT towards structural health monitoring (SHM).

Because of their wide range of applications, the large number of degrees of freedom in the synthesis (comprising the type, position, and excitation of each radiating element in the layout), the available architectures (fully populated, thinned, clustered, etc.), and the possible objectives (maximum directivity, minimum sidelobes, maximum beam efficiency, etc.), the synthesis of arrays turns out to be a very complex task to be tackled with suitable methodologies customized to the application at hand. Indeed, several techniques have been developed in the last sixty years, but despite such a heterogeneity, most of them share a common theoretical framework which is of paramount importance for all engineers and students interested in such a topic.

The objective of the short-course is therefore to provide the attendees the fundamentals of Antenna Array synthesis, starting from intuitive explanations to rigorous mathematical and methodological insights about their behavior and design. In the Part 4 of the course, the so-called 'Conventional' synthesis methods for USLA will be analyzed. More specifically,

- Trial&Test Synthesis Methods
  (e.g., Schelkunoff zero tuning and Fourier synthesis method);
- Optimal Compromise SLL-BW Synthesis Methods
  (e.g., Dolph-Chebyshev method, Taylor synthesis, and Zolotarev method);
- Pattern Matching Synthesis Methods
  (e.g., Fourier method, Woodward-Lawson technique, Least-Square method, and Iterative Projection method).

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