Advanced impedance matching and impedance analysis for antenna applications

Abstract:

The course is targeted for antenna and RF engineers and researchers who study new antenna concepts and who need to use matching circuits in their work. It reviews the definitions of the reflection coefficient, S and Z parameters and the Smith chart and then discuss how matching circuits operate and introduces various loss mechanisms in matching. Simultaneous multiport matching and the design of tunable matching networks will be discussed as well as effects of matching circuit layout. Tools for estimating the obtainable bandwidth and worst-case isolation for non-resonant antennas will be presented. Also, the determination of the correct reference plane in impedance measurements is discussed.

Graphical abstract:

Recommended prerequisites for attendees (if any)*:
The course requires a basic knowledge RF quantities, such as impedances and S parameters

Learning objectives:
After the course the participant will be able to
- Understand the operation of matching circuits
- Design simple matching circuits on the Smith chart
• Understand the optimization criteria for practical matching circuit design in the single port and multiport antenna cases
• Understand the loss mechanisms in impedance matching
• Understand the effects of matching circuit layout
• Understand the effect of incorrect reference planes in impedance measurements to matching circuit design
• Understand methods for estimating the obtainable bandwidth of nonresonant antennas

Course outline:

• Review of definitions of S, Y and Z parameters
• Review of the Smith chart and admittance chart
• Effect of matching components (inductors, capacitors and transmission line) to antenna impedance
• Basic operation and design of matching circuits
• Loss mechanisms in impedance matching, including simultaneous multiport matching
• Design goals for realistic antenna matching circuits
• Design of tunable matching circuits
• Effect of matching circuit layout
• Determination of correct reference plane in impedance measurements
• Tools for estimating the obtainable bandwidth and worst-case isolation for non-resonant antennas

Jussi RAHOLA obtained the M.Sc. (Tech.) and D.Sc. (Tech.) degrees in applied mathematics from Aalto University (former Helsinki University of Technology) in 1990, and 1996, respectively. The topic of his dissertation was the solution of large dense systems of linear equations of electromagnetics using iterative solvers and the fast multipole method. From 1989 to 1999 he was working as an application specialist and a development manager in CSC - IT Center for Science Ltd, Finland. During 1997–1998 he also worked in CERFACS, Toulouse, France as a post-doctoral researcher in the field of computational electromagnetics. From 2000 to 2009 he worked in Nokia Research Center and Nokia Devices R&D as a senior research engineer, research manager and principal scientist in the field of antenna research. In 2009 he founded Optenni Ltd for developing the Optenni Lab circuit synthesis software. He has over 30 publications in international journals and conference proceedings. His research interests include antennas, circuit simulation, impedance matching, computational electromagnetics and numerical mathematics.
Key bibliography: