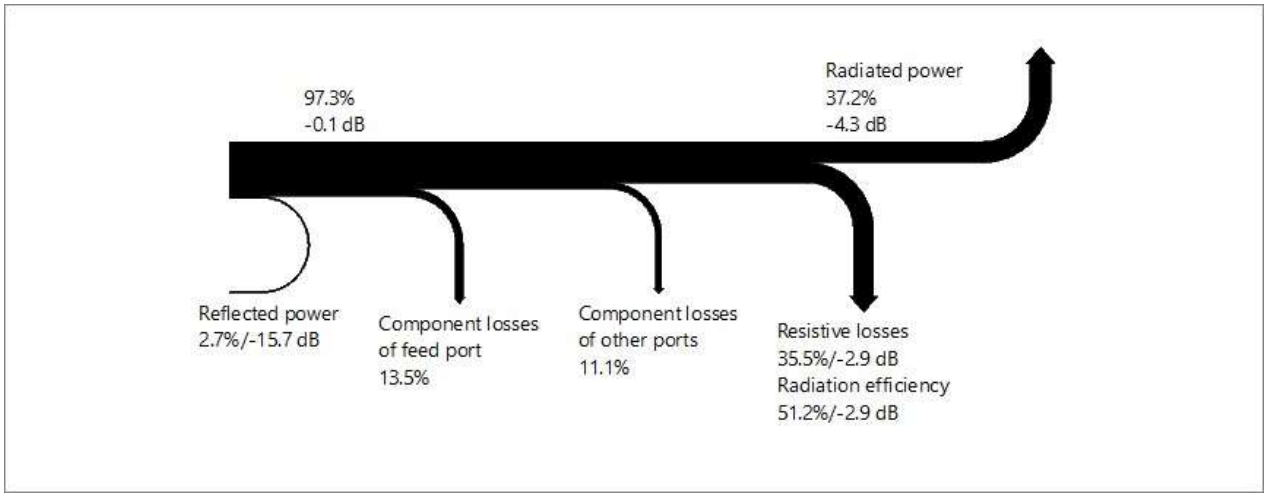
Advanced impedance matching and impedance analysis for antenna applications

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

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Key bibliography:

- J. Rahola, “Optimization of matching circuit for antennas,” in Proceedings of the EuCAP 2011 conference, Rome, April 11-15, 2011.
- J. Rahola, “Simultaneous multiport matching circuit optimization for multiantenna systems,” in Proceedings of the EuCAP 2013 conference, Gothenburg, April 8-12, 2013.
- J. Rahola: “Optimization of frequency tunable matching circuits”, in Proceedings of the EuCAP 2015 conference, Lisbon, April 12-17, 2015.