Universitatea Politehnica Bucuresti

Facultatea de Electronica, Telecomunicatii si Tehnologia Informatiei

O teorie de proiectare in microunde bazata pe geometria lui Klein

A microwave design theory based on the Kleinian view of Geometry

Autor: Drd. ing. Andrei Müller

Conducator: Acad. Dan Dascalu

Abstract

Teza se foloseste in de concepte matematice prezente in arta lui Escher si geometria fractala a lui Mandelbrot si le introduce in teoria de microunde propunand noi instrumente de calcul care unifica proiectarea de circuite pasive si active de microunde. Folosind elemente din teoria grupurilor aplicate in geometrie teza preia unele rezultate din programul lui Felix Klein de la Erlangen –rezultate care permit descompunerea transforamrilor complexe prezente in teoria microundelor in transformari euclidiene, afine si inversive. Lucrand in planul complex extins teza prezinta teoria si aplicatiile unei diagrame Smith 3D care reuseste cu succes sa unifice intr-un mod simplu pe sfera lui Riemann proiectarea unitara de circuite pasive si active. Lucrand in planul complex extins al transformatelor inversive teza propune totodata noi multimi de incluziune pentru liniile cu pierderi, noi metode de calcul pentru cercurile de stabilitate prezente in teoria amplificatoarelor si o noua conditie de stabilitate. Partea practica a tezei prezinta proiectarea, realizarea si masurarea unui filtru trece banda pentru retele WLAN 5200. Rezultatele cele mai vizibile ale tezei se regasesc publicate in jurnale IEEE sau Elsevir.

The thesis uses mathematical concepts that are present also in Escher's art and Mandelbrot's fractal geometry and introduces them in the microwave theory proposing new computation instruments that unify the design of passive and active microwave circuits. Using elements of the group theory applied in geometry the thesis takes advantage of some results of the Klein's Erlangen program, results that allow the decomposition of the complex mappings that are present in the microwave theory in : Euclidian, affine and inversive transformations. Working in the extended complex plane the thesis presents the theory and applications of a 3D Smith char that successfully unifies in a simple manner the unitary design for active and passive circuits on the Riemann sphere. The thesis proposes also new inclusion sets for the lossy transmission lines, new computation methodologies for the stability circles that are used in the amplifier design and a new stability condition. The practical part of the thesis shows the design, realization and measurement of a bandpass filter for WLAN 5200 networks. The most visible results of the thesis were published in IEEE and Elsevir journals.