計畫編號:NSC97-2221-E018-018; 研究期間:200808-200907

以多節步階式阻抗共振器設計超寬頻帶通濾波器之研究

Design of Ultra-Wideband Bandpass Filters Using Multi-Section SIRs

李清和

摘要

本計畫旨在應用改良式半波長(λ/2)三節步階式阻抗共振器(TSSIR)與新型λ/4 SIR 或 TSSIR 組合結構來設計超寬頻(UWB)帶通濾波器(BPF)，並將其實現在平板架構上。本計畫所提之 UWB BPF 設計概念為將 TSSIR、SIR 或其組合結構之前數個共振模態設計於 UWB 頻帶 (3.1 GHz-10.6 GHz)內以形成寬頻響應，並利用耦合微帶線、交錯耦合結構、植入微帶殘段等方式來改善其頻率響應。計畫將分二年執行：第一年之研究規劃主要為數種 UWB BPF 結構，包括具高頻諧振抑制之 UWB BPF、具有頻帶阻隔(band notch) 之 UWB BPF 及多頻-正交分頻多工(multiband orthogonal frequency division multiplexing, MB-OFDM)用之 UWB BPF 等。第二年之研究規劃延續第一年之工作。為了改善 UWB BPF 通帶兩邊之頻率選擇性，我們將以原λ/4 TSSIR 組合結構再加入交錯耦合之電路安排來設計具有通帶兩側零點之 UWB BPF。而為了擁有更寬的截止頻帶，我們亦規劃將多個尺寸漸變之 SIRs 串接成一低通結構，並配合平行耦合饋入(出)設計來

製作寬截止帶之 UWB BPF。此外，近年來環形共振器亦常被用來設計濾波器，故本研究亦嘗試以三節步階式阻抗式環形共振器來設計 UWB BPF。在本計畫第二年之最後，我們將結合田口法(Taguchi’s Method)與單體法(Simplex Method)，將計畫中所規劃之部分 UWB BPF 的設計尺寸予以最佳化。預期本研究之成果將可作為超寬頻帶通濾波器設計之有用參考，所提出之濾波器結構亦具有相當之實用價值。

This project is devoted to the study of employing improved half-wavelength (λ/2) tri-section stepped-impedance resonators (TSSIRs) and combined quarter-wavelength (λ/4) SIRs and TSSIRs to design ultra-wideband bandpass filters (UWB BPFs). The designed UWB BPFs will finally be implemented on planar substrates and be measured and verified. The idea for the UWB BPF design proposed in this project is to have the first several resonant modes of the TSSIR, SIR, or their combined structures located in the desired UWB band (3.1 GHz-10.6 GHz) to obtain a broad band response. Then the techniques of implementing coupled lines, cross-coupled structures, and open stubs are employed to improve the overall frequency response. The proposed research work will be divided in two parts, and be completed in two years. In the first year, several new UWB BPFs will be designed and investigated, including higher-order harmonics suppressed UWB BPFs, band-notched UWB BPFs, and multiband orthogonal frequency division multiplexing (MB-OFDM) UWB BPFs The research work scheduled for

the second year is an extension of the first one. The proposed research topics include the improvement of the UWB BPF passband selectivity, increasing stopband bandwidth in higher frequency region, design of UWB BPF using ring resonators, and filter optimization. To improve the passband skirt sharpness of the UWB BPF, the resonators are further arranged in a cross-coupled fashion to produce a transmission zero on each side of the passband. On the other hand, a low-pass filter consists of cascaded tapered-dimension SIRs can be combined with input/output coupled lines to form a UWB BPF with a wider stopband in the higher frequency region. Besides the TSSIRs and SIRs mentioned above, the tri-section (square and circular) ring resonators are also used in this project to design UWB BPFs due to is popularity in recent years. In the final part of the second year, we will employ a combined approach of the Taguchi's Method and the Simplex Method to optimize the dimension of selected UWB BPFs which were designed and investigated in this project. Results obtained from this project are expected to serve as a useful reference for designers working in this field. And the proposed UWB BPF structures will have practical value for use in the industrial area.

關鍵字：三節步階式阻抗共振器;超寬頻帶通濾波器;

交錯耦合結構;傳輸零點;田口法;單體法

Key words：Tri-section stepped-impedance resonator (TSSIR);

Ultra-wideband bandpass filter(UWB BPF);Cross-coupled configuration;Transmission zero;Taguchi's Method;SimplexMethod