射頻、微波及毫米波被動電路 (RF, Microwave MMW Passive Circuits)

射頻、微波及毫米波被動電路可以概略分成濾波器、耦合器與平衡至非平衡轉換器(balun)等，以及基本的微波電路元件。茲分別敘述於下:

1. 濾波器

濾波器與頻率多工器在台灣學界近幾年有很長足進步,對於國際微波工程學術研究也有相當的貢獻。在國際學術研討會上，這一研究領域的論文通常數量最大，參與人數最多。以下幾項為目前研究之重點：

(1) 濾波器創新的耦合架構(coupling scheme)：屬於濾波器設計的基礎工程，配合通帶甚至截止帶頻率響應之合成，其研究、診斷與實現等，都相當值得研究 [7.1, 7.2]，目前在我國這方面的研究論文表現並不多見。

(2) 濾波器止帶傳輸零點的研究：在截止帶中產生零點是一個很熱門、很實用、也很受到學界重視的研究題目，例如經由選定傳輸線諧振腔饋入位置而產生之零點[7.3]、交錯耦合而產生之傳輸零點[7.4]、信號源與負載端埠耦合之傳輸零點[7.5]等。

(3) 適用於UWB及其他無線通訊系統之寬頻濾波器之發展:寬頻濾波器其頻寬大多大於60%,此種寬頻濾波器在電路合成理論與實現的典型實例如[7.6, 7.7]，甚至最近也有相當多在UWB通帶加入截止帶的研究[7.8, 7.9]。

(4) 多模諧振腔(MMR)濾波器：可以用一個物理上的諧振腔製作高階濾波器，研究重點是物理上單一諧振腔提供多個諧振模，所以設計高階濾波器時，可以使用少量數目的諧振腔，達到節省空間目的，這是最近學術界很受重視的研究題目[7.9-7.11]。

(5) 平衡式濾波器之發展：由於降低雜訊考量，射頻與微波積體電路多使用平衡式輸入與輸出端埠，因此若濾波器能設計成平衡式的濾波器即可容易與積體電路的輸出入埠匹配，這是傳統單端式濾波器所沒有的優點 [7.12, 7.13]。

(6) 小型化與三度空間化之濾波器：利用多層式與三度空間結構，縮小濾波器的尺寸與改善其性能。如低溫共燒陶瓷(LTCC) [7.14]、薄膜[7.15]、多層印刷電路板[7.16] 等。

(7) 多通帶濾波器：自2005年左右開始，多通帶濾波器之論文數量相當多，一方面業界有需求,一方面從電路設計觀點看,對學術研究也有相當程度挑戰性，因此投入研究的人很多,產出的論文也相當多樣化,非常值得繼續研究 [7.17, 7.18]。

(8) 可重置與可調濾波器：每年的國際微波會議(IMS)中，可重置或可調整濾波器的場次(sessions)均會吸引相當多的聽眾參與，因為在業界有相當的需求，國內目前這方面的研究較少，典型的論文如 [7.19, 7.20]。

(9) SIW濾波器：整合基板波導(SIW)結構與傳統矩型波導結構相近，但容易與平面式電路整合，損耗低，佔用體積小，所以也有相當多新穎的研究[7.21, 7.22]。

2. 耦合器與平衡至非平衡轉換器(balun)

耦合器在IEEE TMTT與IEEE MWCL國際期刊的研究論文數量均相當豐富，我國在這方面的研究也相當活躍。耦合器在功能上可以分成90度與180度之耦合器，平衡至非平衡轉換器則為三埠元件，將訊號一分為二且相位差180度。相關的熱門研究主題如下：

(1) 分支線(branch line)與岔路環(rat-race ring) 90度與180度之耦合器：這是一個很基本、很重要，在微波與天線系統中也很常用的微波元件，雖然相關論文已經相當多，但配合新的微波元件發展如週期性結構[7.23]或左手傳輸線[7.24]、三度空間結構如非完美地平面(defect ground plane) [7.25]、垂直式基板[7.26]等，各式創新合成[7.27]與設計，包括縮小面積[7.28]、延伸上截止帶[7.29]、雙頻設計[7.30]，相信未來仍具有很大的創新發展的空間。

(2) 寬頻與超寬頻耦合器：直覺上，具有寬頻以上的耦合器，需要很強的耦合量[7.31, 7.32]，學術上的挑戰性很高。

(3) 新的平衡至非平衡轉換器結構：傳統的Marchand平衡至非平衡轉換器已經有大量的研究，至於新的平衡至非平衡轉換器仍不斷的有人提出，所以這仍是一個很值得研究的題目[7.33-7.35]。

(4) 平衡至非平衡濾波器：這是一個很有用的元件，以往都是將平衡至非平衡轉換器與普通的濾波器相結合，最近將之視為一個電路元件整體設計是一個新的趨勢，因此它也是一個值得研究的題目 [7.36, 7.37]。

(5) 新式耦合器設計與應用：諸如crossover [7.38-7.40].

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