Analysis of Design concepts for Microstrip Filters at Microwave Range

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Abstract— Microwave filters are designed using many techniques and procedures. This paper presents the exhaustive survey of the major techniques used in the design of microwave filters. These filters are used in various communications systems like satellites, earth stations, wireless base-stations and repeaters. This paper provides a brief review of the work in the field of Microstrip Filters. Phenomenal growth in the telecommunication industry in recent years has brought significant advances in filter technology as new communication systems emerged, demanding more stringent filter characteristics. The growth of the wireless communication industry has spurred tremendous activity in the area of microwave filter miniaturization, increasing power handling capabilities and has been responsible for many advances made in this field. In this paper a survey of the major techniques used in the design of microwave filters is presented. The theoretical and experimental work in different types of Microstrip Filters around the world is illustrated. It covers basic principles, methods, technology selection criteria, design trade off and application limitations.

Keywords— Microstrip filters, hairpin line, high-pass, low-pass, Band-pass, Band-stop, lumped element.

I. Introduction

In any communication system the filters play an important role. Filters are generally used to select/reject or combine different frequencies as per requirement of the application. It is evident that the electromagnetic spectrum is limited and has to be shared assigned band of frequency need to be used for particular service. Emerging applications such as wireless communications continue to challenge RF/microwave filters with ever more stringent requirements like higher performance, lighter weight, smaller size, and lower cost. Depending on the requirements and specifications, RF/microwave filters may be designed a slumped element or distributed element circuits and are realized on various transmission structures, such as waveguide, coaxial line, and microstrip. Recent advances of materials and fabrication technologies, including monolithic microwave integrated circuit, micro electro mechanic system (MEMS), high-temperature superconductor (HTS), and low-temperature co fired ceramics (LTCC), has further guided the rapid development of new microstrip and other filters. The function of a filter is well known and has been established its domain in communication technology. Thus clearly there is a passband and a stopband for filters in communication systems. Ideally in the passband there should be no attenuation while in the stopband there should be maximum attenuation. However, with real components, such as inductors, capacitors, transmission lines and waveguides that is not the case. Contrary to the ideal case in the passband there is some attenuation, which can be controlled by improving the design and by proper choice of components. Similarly in the stopband the attenuation can be controlled. The filters can be low-pass, high-pass, band-pass, and band-stop type. At lower frequencies lumped element inductors and capacitors can be used to design filters while at microwave frequencies usually transmission line sections and waveguide elements are used.

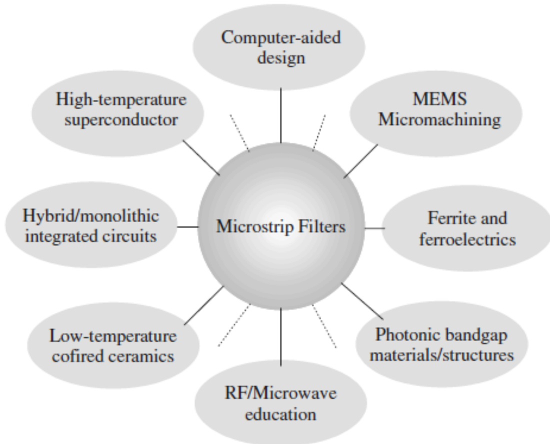

Figure 1: Microstrip Filter Linkage

In mobile wireless devices a different type of filter is used, which are compact and sharp cutoff. It is called the SAW (surface acoustic wave) filter. In this scheme a piezoelectric material is used in integrated form to create surface acoustic waves that provides the filter characteristic. Filters are essentially frequency selective elements. The filters have such behavior, which results frequency dependent reactance provided by inductive and capacitive components. In microwave frequencies lumped element inductors and capacitors cannot be used and thus transmission line sections are used which behave as inductors and capacitors. Minimizing the losses in the passband of a filter is extremely important since it not only reduces the overall losses for a transmitter but also improves the noise figure when used with a receiver. Filters can be designed using the image parameter or the insertion loss methods. In the image parameter method design is rather simple. However, the response in the passband and the stopband cannot be precisely controlled. In the insertion loss method design starts with a low-pass prototype based on maximally flat or Chebyshev response and the insertion loss in the passband as well as in the stopband can be defined and controlled based on the number of sections chosen and the components used.

II. Network Conversion For A Filter

Most RF/microwave filters and filter components can be represented by a two-port network, as shown in Figure 2, where V_1, V_2 and I_1, I_2 are the voltage and current variables at the ports 1 and 2, respectively, Z_{01} and Z_{02} are the terminal impedances, and E_s is the source or generator voltage. Note that the voltage and current variables are complex amplitudes when we consider sinusoidal quantities. For example, a sinusoidal voltage at port 1 is given by

$$v_1(t) = |V_1|\cos(\omega t + \varphi) \quad (1)$$

We can then make the following transformations:

$$v_1(t) = |V_1|\cos(\omega t + \varphi) = \mathrm{Re}(|V_1|e^{j(\omega t + \varphi)}) = \mathrm{Re}(V_1 e^{j\omega t})$$

(2)

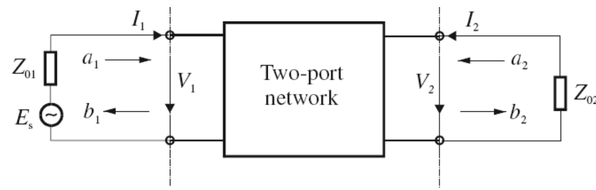

Figure 2 :Two-Port Network Showing Network Variables

Where Re denotes "the real part of" the expression that follows it. Therefore, one can identify the complex amplitude V_1 defined by

$$V_1 = |V_1|e^{j\varphi} \quad (3)$$

Because it is difficult to measure the voltage and current at microwave frequencies, the wave variables a_1, b_1 and a_2, b_2 are introduced, with a indicating the incident waves and b the reflected waves. The relationships between the wave variables and the voltage and current variables are defined as:

$$V_n = \sqrt{Z_{0n}}(a_n + b_n)$$

$$I_n = \frac{1}{\sqrt{Z_{0n}}}(a_n - b_n) \qquad n = 1 \text{ and } 2 \qquad (4)$$

$$a_n = \frac{1}{2}\left(\frac{V_n}{\sqrt{Z_{0n}}} + \sqrt{Z_{0n}}I_n\right)$$

$$b_n = \frac{1}{2}\left(\frac{V_n}{\sqrt{Z_{0n}}} - \sqrt{Z_{0n}}I_n\right) \qquad n = 1 \text{ and } 2 \qquad (5)$$

The above definitions guarantee that the power at port n is

$$P_n = \frac{1}{2}\mathrm{Re}(V_n . I_n^*) = \frac{1}{2}(a_n a_n^* - b_n b_n^*) \quad (6)$$

III. Scattering Parameters

The scattering or S parameters of a two-port network are defined in terms of the wave variables as

$$S_{11} = \left.\frac{b_1}{a_1}\right|_{a_2=0} \qquad S_{12} = \left.\frac{b_1}{a_2}\right|_{a_1=0}$$

$$S_{21} = \left.\frac{b_2}{a_1}\right|_{a_2=0} \qquad S_{22} = \left.\frac{b_2}{a_2}\right|_{a_1=0}$$

Where $a_n = 0$ implies a perfect impedance match (no reflection from terminal impedance) at port n. These definitions may be written as

$$\begin{bmatrix} b_1 \\ b_2 \end{bmatrix} = \begin{bmatrix} S_{11} & S_{12} \\ S_{21} & S_{22} \end{bmatrix} \cdot \begin{bmatrix} a_1 \\ a_2 \end{bmatrix} \qquad (8)$$

where the matrix containing the S parameters is referred to as the scattering matrix or S matrix, which may simply be denoted by [S]. The parameters S_{11} and S_{22} are also called the reflection coefficients, whereas S_{12} and S_{21} the transmission coefficients. These are the parameters directly measurable at microwave frequencies. The S parameters are in general complex, and it is convenient to express them in terms of amplitudes and phases, i.e., $S_{mn} = |S_{mn}| e^{j\varphi_{mn}}$ for m, $n = 1, 2$. Often their amplitudes are given in decibels (dB), which are defined as

$$20 \log|S_{mn}| \text{ dB} \qquad m, n = 1, 2 \qquad (9)$$

where the logarithm operation is base 10.
For filter characterization, we may define two parameters:

$$L_A = -20 \log|S_{mn}| \text{ dB} \qquad m, n = 1, 2 (m \neq n)$$
$$L_R = 20 \log|S_{nn}| \text{ dB} \qquad n = 1, 2 \qquad (10)$$

Where L_A denotes the insertion loss between ports n and m and L_R represents the return loss at port n. Instead of using the return loss, the voltage standing wave ratio $VSWR$ may be used. The definition of $VSWR$ is

$$VSWR = \frac{1 + |S_{nn}|}{1 - |S_{nn}|} \qquad (11)$$

The mathematical analysis provided in this section helps in design specifications and probable design of filters according to their application and area.

IV. Work Reported

In this section the work reported by researcher in this field is discussed and analysed for different parameters as suggested by them. **Dawei zhang et al. proposed narrowband lumped-element microstrip filters using capacitively-loaded inductors [2].** A class of lumped-element filters has been developed that uses capacitively-loaded inductors to give frequency dependent inductance values. The technique used in this design process called novel frequency transformation and using this approach, strong coupling can be used in narrowband filter designs. The frequency-dependent inductance transforms the filter to a narrower bandwidth than the original circuit prototype, and does not require hard-to-realize weak coupling. 0.3% bandwidth superconducting microstrip prototype filter is presented. It was designed with the coupling of a 1 % bandwidth filter, and then transformed to 0.3% fractional bandwidth using an appropriate inductance slope parameter. A frequency transformation technique is applied to transform the filter bandwidth from the wideband circuit prototypes to narrowband filters.

Guo-Chun Liang et al. proposed High power HTS microstrip filters for wireless applications [3]. They developed a technique to visualize the power dissipation of the filter by observing the bubbles created by the filter when submerged in liquid helium, showing areas with local defects or where the current distribution is at its peak value. several planar high-power filter issues are also discussed, including material selection and fabrication, device configuration trade-offs, filter structure optimization, and design approaches to maximize power-handling capacity. Design techniques for maximizing the power-handling capabilities of these filters, such as the use of low-impedance resonators, were presented. Two types of filters with low internal characteristic impedances are reported. One mixed backward- and forward- coupled has handled over 25 watts at 10 K. Another type of filter reported is a forward coupled. One of them has 1.2% BW and 10-ohm resonator internal impedance and handled more than 10 watts of power at 50 K. Second purely forward-coupled filter handled 36 watts of power at 45 K, with a maximum band edge compression of 0.15 dB as the applied input power increases to 36 watts.

Stephen V. et al. proposed Micromachined Self-Packaged W-Band Bandpass Filters [4]. Which are fabricated using silicon micromachining and membrane technologies. Micromachining of multiple wafers provides a shielded assembly which can be integrated as a self-packaged unit. The filters display excellent performance as measured on a W-Band probe station, including low passband insertion loss and high out of band signal rejection. Filter performance is presented using commercially available software and FDTD techniques.

Antonio et al. proposed Enhanced-Q Microstrip Bandpass Filter with Coupled Negative Resistors [5]. Microstrip technology offers a very compact realization of a microwave filter. Unfortunately, the losses in normal thin-films are usually so excessive that narrowband microstrip filters are impractical. However, high-Q microstrip filters can be realized by augmenting them with active elements. Microstrip bandpass filter with negative resistors coupled to each resonator is presented. The negative resistors negate the losses in each resonator and yield an enhanced-Q. A new theoretical framework for this Q-enhancement technique and a design methodology are presented. The simulated and measured performance of the filter are compared. Author described the development of an active microstrip filter using coupled negative resistors for Q enhancement of each resonator.

Jia-Sheng Hong et al. proposed the Theory and Experiment of Novel Microstrip Slow-Wave Open-Loop Resonator Filters [6]. A comprehensive treatment of capacitively loaded transmission line resonator is described, which leads to the invention of microstrip slow-wave open-loop resonator. The utilization of microstrip slow-wave open-loop resonators allows various filter configurations including those of elliptic or quasi-elliptic function response to be realized. The filters are not only compact size due to the slow-wave effect, but also have a wider upper stop-band resulting from the dispersion effect. These attractive features make the microstrip slow-wave open-loop resonator filters good for mobile communications, superconducting and other applications. Author performed the full-wave EM simulation to confirm the circuit theory. It has been demonstrated that the use of the microstrip slow-wave open loop resonators allows various filter configurations including those of elliptic or quasi-elliptic function response to be realized that are not only compact size due to the slow-wave effect, but that also have a wider upper stop-band resulted from the dispersion effect. They described in detail the two filter designs using microstrip slow-wave open-loop resonators. The design parameters can be obtained based on the prototype circuits, and the coupling coefficients and external quality factor associated with the microstrip. slow-wave open-loop resonators can be characterized in the light of the full-wave simulation.

Lei Zhu et al. proposed A Joint Field/Circuit Model of Line-to-Ring Coupling Structures and Its Application to the Design of Microstrip Dual-Mode Filters and Ring Resonator Circuits [7]. The generic model is derived from field theory and presented in terms of circuit elements by applying a newly developed numerical deembedding technique called “short-open calibration” in a deterministic method-of-moments scheme. It provides a new design strategy for characterizing and optimizing electrical performance of the line-to-ring coupling structures. Such three-port topologies are explicitly formulated by using an equivalent network having circuit elements calculated by the proposed joint field/circuit model. A joint field/circuit model is proposed for accurate and efficient design of high-frequency integrated planar circuits with particular emphasis on line-to-ring coupling structures. The proposed joint field/circuit model provides a new design strategy for the line to- ring three-port coupling schemes that are usually considered as a difficult issue in accurate design and optimization. The three types of line-to-ring coupling topologies together with the conventional one are characterized in depth and studied theoretically and experimentally for use in resonator circuits. The appropriate choice of coupling topology is important for the optimized design and miniaturization of ring circuits.

Jia-Sheng Hong et al. proposed Aperture-Coupled Microstrip Open-Loop Resonators and Their Applications to the Design of Novel Microstrip Bandpass Filters[8]. The new filter configuration consists of two arrays of microstrip open-loop resonators that can be coupled through the apertures on the common ground plane. Depending on the arrangement of the apertures, different filtering characteristics can easily be realized. Electromagnetic modeling of the aperture couplings is presented. Three experimental filters of this type with Chebyshev, elliptic function, and linear phase response respectively, are described together with theoretical and experimental results. The filter asymmetric responses associated with frequency-dependent couplings are investigated. the investigation of two types of aperture-coupled microstrip open-loop resonators in a multilayer configuration is presented. These two coupling structures are essential components for a new class of compact microstrip bandpass filters. different filtering characteristics can easily be realized by the proposed filters. For demonstration, three four-pole band pass filters of this type with Chebyshev, elliptic function, and linear phase responses, respectively, have been designed, fabricated, and tested. The measured results together with the theoretical ones have been presented. The issue of frequency-dependent couplings has been addressed. It has been shown that the new class of filters hold promise for wireless and mobile communications applications. The new filter configuration is also attractive for HTS thin-film implementation.

Cam Nguyen proposed the Microstrip spurline band-pass filters [9]. These filters exhibited insertion losses of less than 1 and 1.3 **dB** and return Losses of more than 20 and 15 **dB** in the pass bands centered near 5 ***GHz.*** They obtained a good agreement between the measured and calculated performances. These filters behave similarly to the conventional open-circuited shunt-stub band-pass filters, but are smaller and have less radiation, dispersion, and sensitivity to the adjacent objects. They also derived approximate design equations for these filters. These filters are more useful than their counterparts that employ open-circuited shunt stubs because they are more compact and have less radiation, dispersion, and sensibility to nearby objects.

Wang et al. proposed Neural Network Structures and Training Algorithms for RF and Microwave Applications [10]. Neural network technology is an emerging technology in the microwave area for microwave modeling, simulation, optimization, and design. The efficient development of an accurate neural model requires a proper neural network structure and suitable training algorithms, two important aspects in successful applications of neural networks in solving microwave design problems. This paper presented a review of the current status of this area. The subject of neural network architectures and training algorithms in general is large. Standard feed forward neural networks, neural network structures with prior knowledge, combining neural networks and constructive network structures, are described. various training algorithms including the back propagation algorithm and its variants, training algorithms based on classical optimization techniques such as conjugate gradient and quasi-Newton algorithms, training algorithms based on decomposed optimization, and global minimization techniques are suggested. Neural networks have a very promising future in the microwave design area. Benefits of applying neural network technology can be potentially achieved at all levels of microwave design from device, components, to circuits and systems, and from modeling, simulation, to optimization and synthesis. From the research point of view, future work in structures and training algorithms will shift from demonstration of basic significance of the neural network technology to addressing challenges from real microwave applications. Neural networks, with their unparalleled speed advantage, and their ability to learn and generalize wide variety of problems, become the important tool helping in microwave design.

Cho et al. proposed the EM-ANN Modeling of Overlapping Open-Ends in Multilayer Microstrip Lines for Design of Bandpass Filters [11]. They described Electromagnetic-Artificial Neural Network modeling based on EM simulation results (EM-ANN) for overlapping gap coupled sections of microstrip lines used in the design of multilayer end-coupled band-pass filters. The overlapping gaps are used for obtaining a wide bandwidth. An EM-ANN model has been developed successfully for reducing the design time. Also, a design for multilayer end-coupled band-pass filter has been performed using this model and compared to the design without using ANN models. An end-coupled band-pass filter in a 2-layer configuration has been designed using ANN. Overlapping gaps between resonators in two-layer configuration make it possible to design wideband filters. In order to reduce to the time for optimization of gap parameters, ANN models have been used.

Bakr et al. proposed for the first time Neural Space-Mapping Optimization for EM-Based Design [12].NSM optimization exploits our space-mapping (SM)-based neuromodeling techniques to efficiently approximate the mapping. A novel procedure that does not require troublesome parameter extraction to predict the next point is proposed. The initial mapping is established by performing upfront fine-model analyses at a reduced number of base points. Coarse-model sensitivities are exploited to select those base points. Huber optimization is used to train, without testing points, simple SM-based neuromodels at each NSM iteration. The technique is illustrated by a high-temperature superconducting quarter-wave parallel coupled-line microstrip filter and a bandstop microstrip filter with quarter-wave resonant open stubs. Author presented an innovative algorithm for EM optimization based on SM technology and ANNs. An HTS quarter-wave parallel coupled-line microstrip filter and a bandstop microstrip filter with quarter-wave resonant open stubs illustrate our optimization technique.

Hong et al. proposed the Design of Highly Selective Microstrip Bandpass Filters with a Single Pair of Attenuation Poles at Finite Frequencies[13].A practical design technique for this class of filters is introduced, including tables and formulas for accurate and fast filter synthesis. Two design examples of a six-pole filter with a fractional bandwidth of 7.331% at 955 MHz and an eight-pole filter with a fractional bandwidth of 10.359% at 985 MHz are described. The compact size and the excellent performance of this class of filters have been demonstrated. This class of filters is able to improve the selectivity while maintaining a lower insertion loss. The use of microstrip open-loop resonators not only allows the cross coupling to be realized, but also makes the filters compact. Author has introduced a practical design technique, including the tabulated design data and formulas for accurate and fast filter synthesis.

Hong et al. proposed the Microstrip triangular patch resonator filters[14]. They presented primary development of microstrip bandpass filters comprised of triangular patch resonators for high temperature superconducting (HTS), micro machined circuits and other applications. Advantages of using a triangular patch resonator filter are not only its higher capability of power handling, but also its natural circuit topology that can inherently implement finite frequency transmission zeros in a simple cascading structure. In order to have the transmission zeros on the either side of the pass band, two different resonant modes of triangular patch resonators are employed. Microstrip triangular patch resonator filters could have some advanced filtering characteristics in a simple circuit topology of cascading resonators. The utilization of each of the two different resonant modes allows the finite-transmission zero to be arranged on the either side of the passband.

Kenneth et al. proposed the Design of Microstrip Six-Pole Quasi-Elliptic Filter with Linear Phase Response Using Extracted-Pole Technique[15]. Quasi-elliptic response filters are very popular in communication systems because of their high selectivity, which is introduced by a pair of transmission zeros. Author reviewed the design equations of the extracted-pole filter for microstrip. They presented a new class of microstrip filter. This class of filter will have a quasi-elliptic function response and at the same time linear phase in the passband. The linear phase of the filter is introduced by an in-phase cross coupling, while the transmission zero is realized using an extracted-pole technique. Author proposed a new way to achieve both high selectivity and linear phase in the passband for microstrip filters .The structure allows for a sixth-order minimum. This new structure originated fromTE_{011}-mode waveguide filters. The transmission zero pair at the imaginary axis is extracted from the transfer function and realized separately with a pair of bandstop filters and phase shifters connected to the end of the main coupling structure. A circuit model of the microstrip extracted pole is also presented. This model makes the design of microstrip extracted-pole technique for quasi-elliptic function filter more straight forward. To demonstrate the validity of the circuit model, a six-pole quasi-elliptic microstrip filter was designed, fabricated, and tested. The measurement circuit model, together with the theoretical response, has been presented. By introducing an in-phase cross coupling in the microstrip extracted-pole filter, a linear phase filter with a real transmission zero pair can be achieved.

Namiki et al. proposed the Numerical Simulation of Microstrip Resonators and Filters Using the ADI–FDTD Method [16]. Author derived the characteristics of typical and practical microstrip components such as microstrip linear resonators and microstrip low-pass filters using the alternating-direction- implicit–finite-difference-time-domain (ADI–FDTD) method to examine the calculation accuracy and efficiency of the method. The resonators and the filters included very narrow gaps and strips, respectively. In this case, very fine cells must be applied there for the finite-difference time-domian (FDTD) modeling. In the conventional FDTD method, fine cells cause a reduction of the time-step size because of the Courant Friedrich–Levy (CFL) stability condition, which results in an increase in calculation time. In the ADI–FDTD method, on the other hand, a larger time-step size than the CFL stability condition limitation could be set. Author compared the results of the ADI–FDTD method for various time-step sizes with the results of the conventional FDTD method and measured data. In this work, numerical simulations of typical and practical microstrip components, such as microstrip linear resonators and microstrip low-pass filters, using the ADI–FDTD method have been presented. The results of the simulations are compared with those of the conventional FDTD method and measured data in terms of accuracy and efficiency. Author reconfirmed that the ADI–FDTD method guarantees a stable calculation in any time-step size and that a large time-step size reduces both the number of time–loop iterations and the required CPU time for the calculation. but a large time-step size causes numerical errors. In other words, the tradeoff resulting from an increase in time-step size is an increase in numerical errors. Since the increase in time-step size shifted the response downward in terms of frequency, the numerical errors are most likely caused by numerical dispersions.

Lopetegi et al. proposed the New Microstrip "Wiggly-Line" Filters With Spurious Passband Suppression[17]. A new parallel-coupled-line microstrip bandpass filter with suppressed spurious passband is presented. Using a continuous perturbation of the width of the coupled lines following a sinusoidal law, the wave impedance is modulated so that the harmonic passband of the filter is rejected while the desired passband response is maintained virtually unaltered. This strip-width perturbation does not require the filter parameters to be recalculated and, this way, the classical design methodology for coupled-line microstrip filters can still be used. The strip-width modulation for each coupled-line section follows a sinusoidal law whose spatial periodicity must be matched to the wavelength of the harmonic of the design frequency to be rejected. This way, enhanced out-of-band behavior can be obtained while maintaining the main passband virtually unaltered. This technique has important advantages since the wiggle of the lines does not force the prototype parameters to be recalculated.

Lancaster et al. proposed the recent progress in planar microwave filters[18]. The recent development of advanced planar microwave filters for RF/microwave applications are described. These include cascaded quadruplet (CQ) filters, filters with asymmetrical transmission zeros at finite frequencies, and miniature slow-wave filters. An 8-pole microstrip filter of this type has been designed, fabricated and tested. The filter exhibits two pairs of attenuation poles at finite frequencies, which result in a high selectivity. Microstrip filters using patch or line resonators and having finite-frequency transmission zeros on either sides of passband was demonstrated. A miniature high-temperature superconducting (HTS) bandpass filter using novel slow-wave half-wavelength coplanar waveguide (CPW) resonators has been developed. The experimental results was in good agreement with the simulated responses. It is demonstrated that a microstrip triangular patch resonator filter and a pseudocombline filter, both are able to produce finite-frequency transmission zeros on either sides of pass band.

Andrzej S. Ciminski proposed the artificial neural networks modeling for computer-aided design of microwave filter [19]. Microwave models have sufficient accuracy but they are too slow for same aspects of design purposes. Neural network model can take into consideration more variables and allows more nonlinearity without implying an unacceptable increase of the computational coast. Summing above, ANN applications in microwave CAD appear to be very promising. In the near future ANN will probably be used not as an alternative to existing model-based CAD tools but rather as a useful and necessary complement. This work presents an example of ANN usefulness in microwave filter design process. The filter consists of four segments. Every segment is represented by electromagnetically trained neural network model (EM-ANN). Furthermore EM-ANN model maps a set of scattering parameters of coupled microstrip lines (CML) in terms of its geometric dimensions.

Harle et al. proposed a Vertically Integrated Micromachined Filter [20].A 10-GHz filter constructed of slot-coupled micromachined cavities in silicon is presented. The novel character of the filter lies in its structure, which consists of a microstrip feed to cavities via slot apertures and three vertically stacked slot-coupled cavities. The cavities are essentially reduced-height waveguide resonators. The simulated model has a bandwidth of 4% with an insertion loss of 0.9 dB at 10.02 GHz. The measured filter yields a 3.7% bandwidth with a deembedded insertion loss of 2.0 dB at 10.01 GHz. Various loss mechanisms are examined to explain the difference between simulated and measured insertion loss. A multiple-pole micromachined

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vertically integrated bandpass filter has been successfully demonstrated for the first time. It is light weight, of compact size, and may be easily integrated into a monolithic circuit. Loss is introduced because measurement of the circuit requires complex feed structures and the gold surfaces suffered a loss of conductivity during fabrication.

V. Conclusion

In this paper a brief review of the few landmark works has been presented and analysed that you may use any technique, still you can achieve perfect design provided performance parameters are taken care-of as desired by particular application. The paper emphasizes on work in the field of Microstrip filters. The theoretical and experimental work in different types of Microstrip filters around the world is illustrated. Different techniques and modeling techniques for designing Microstrip filters is presented. The techniques could be further improved with the slight considerative approach as per application requirement and proper design parameters.

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