

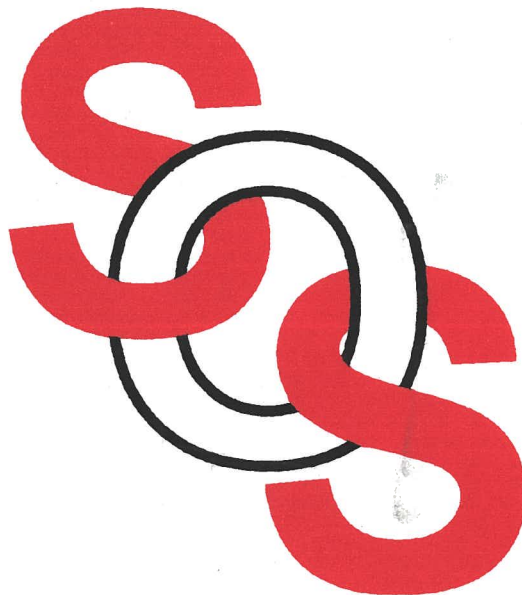
**APPLICATIONS EXPLOITING COMMERCIAL EM
SIMULATORS INCLUDING WAVEGUIDE
STRUCTURES, MICROSTRIP FILTERS
AND PATCH ANTENNAS**

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presented at

**WORKSHOP ON NEXT GENERATION OPTIMIZATION METHODOLOGIES
FOR WIRELESS AND MICROWAVE CIRCUIT DESIGN**

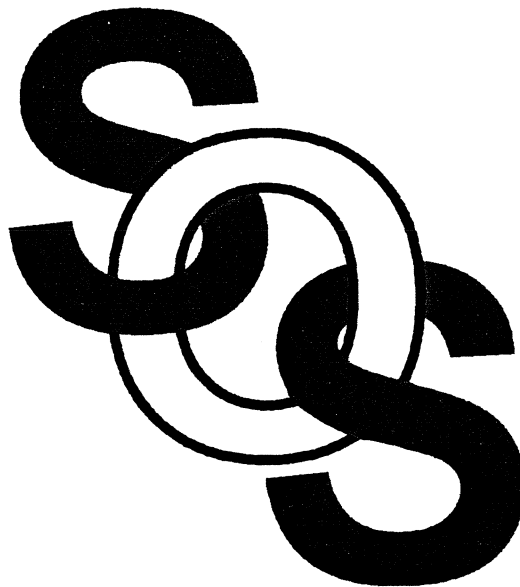
McMaster University, June 28, 1999

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Three-Section Waveguide Transformer

(Bandler et al., 1996)

design specifications

$$v_{swr} \leq 1.04 \text{ for } 5.7 \text{ GHz} \leq f \leq 7.2 \text{ GHz}$$

the designable parameters are the heights of the waveguide sections b_1 , b_2 and b_3 and the lengths of waveguide sections L_1 , L_2 and L_3

the fine model exploits HP HFSS through HP Empire3D

the coarse analytical model does not take into account the junction discontinuity effects

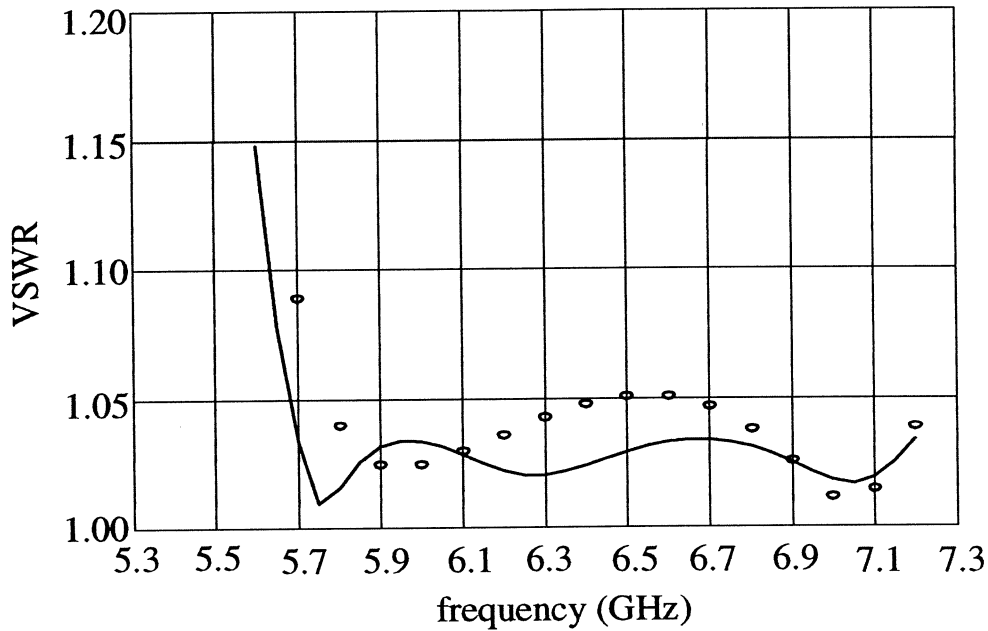
the first phase executed 2 iterations which required 4 fine model simulations

the second phase carried out only 1 iteration which required 2 fine model simulations

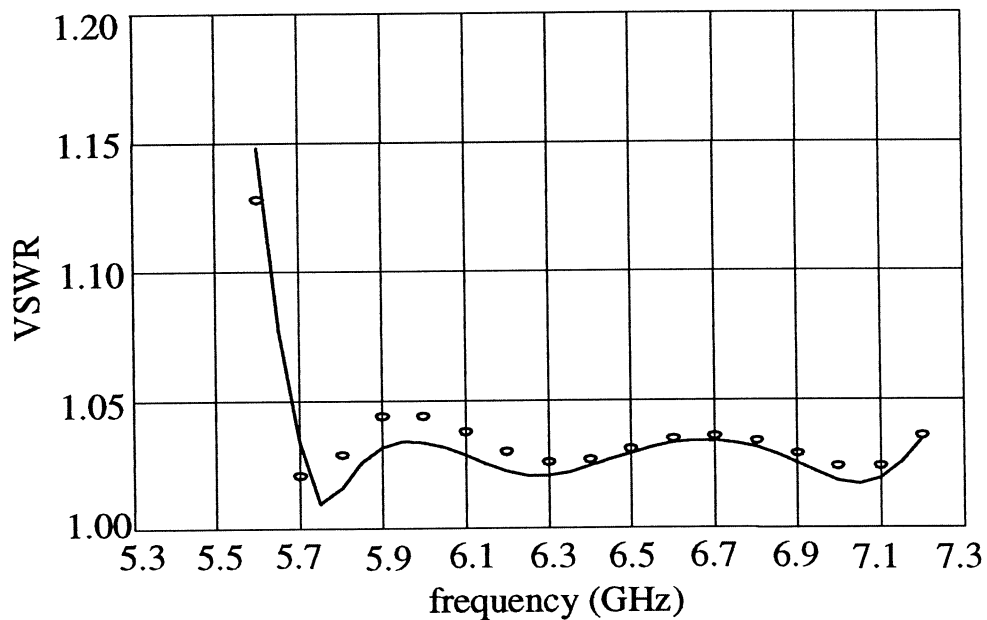
minimax optimization is then applied to the original problem starting from the second phase design



Optimization Results for the Three-Section Waveguide Transformer



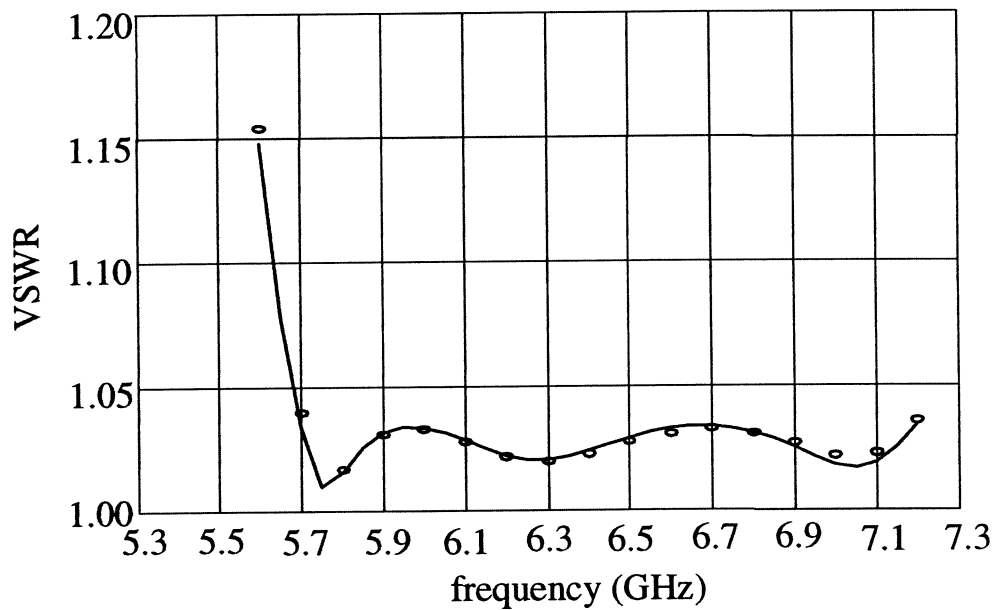
the initial fine model design



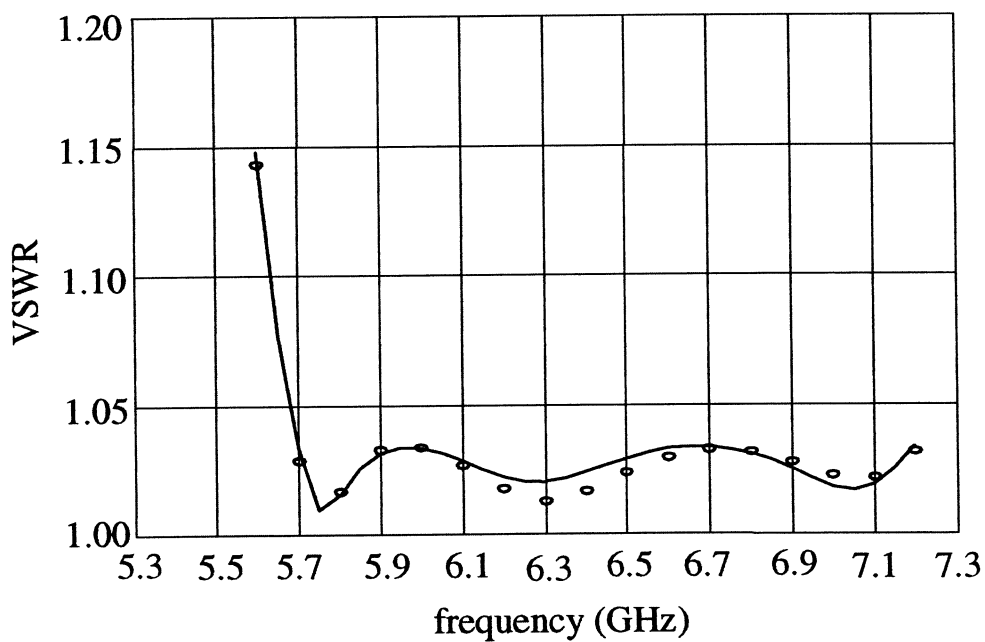
the first phase design



Optimization Results for the Three-Section Waveguide Transformer



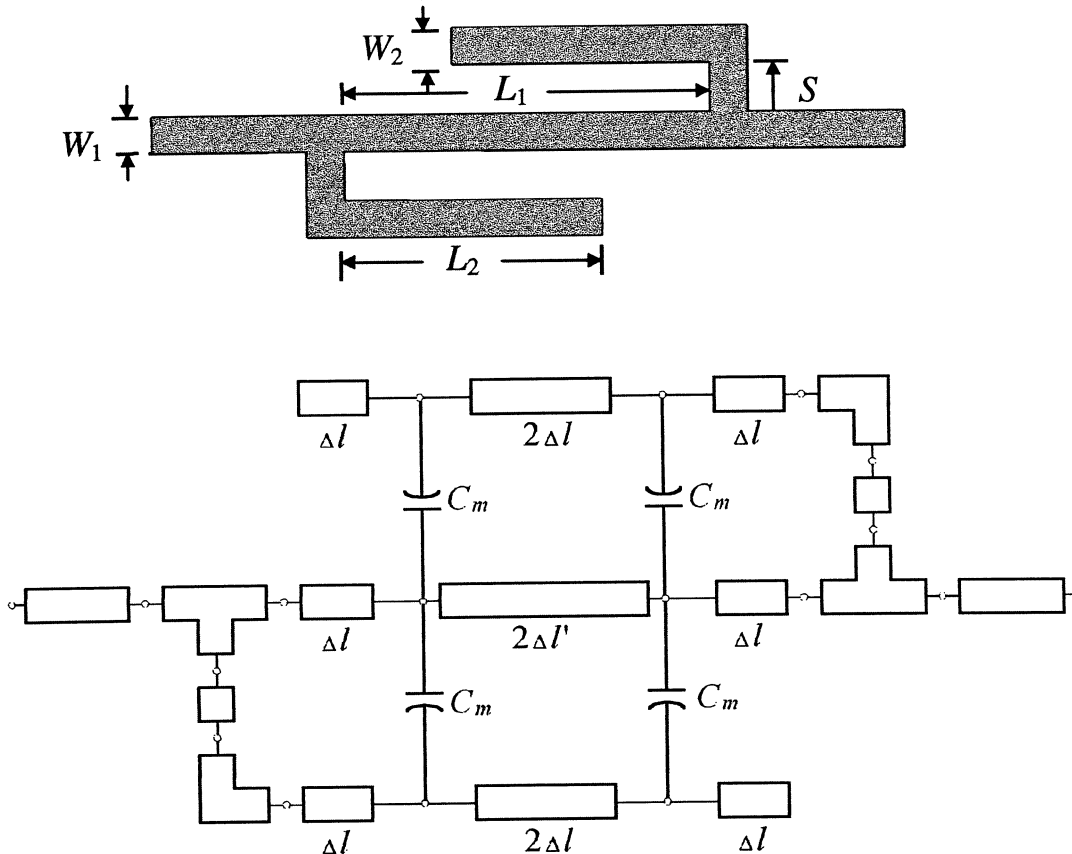
the second phase design



the optimal fine model design



Double-Folded Stub Microstrip Filter (Bandler et al., 1994)



the fine model is the structure simulated by HP HFSS through HP Empipe3D

the coarse model exploits the microstrip line and microstrip T-junction models available in OSA90/hope

the coupling between the folded stubs and the microstrip line is simulated using equivalent capacitors (Walker, 1990)



Double-Folded Stub Microstrip Filter

the folding effect of the stub is included utilizing the bend model
(*Jansen et al., 1983*)

design specifications are

$$|S_{21}| \geq -3 \text{ dB for } f \leq 9.5 \text{ GHz and } 16.5 \text{ GHz} \leq f$$

and

$$|S_{21}| \leq -30 \text{ dB for } 12 \text{ GHz} \leq f \leq 14 \text{ GHz}$$

W_1 and W_2 are fixed at 4.8 mil

L_1 , L_2 and S are chosen as optimization variables

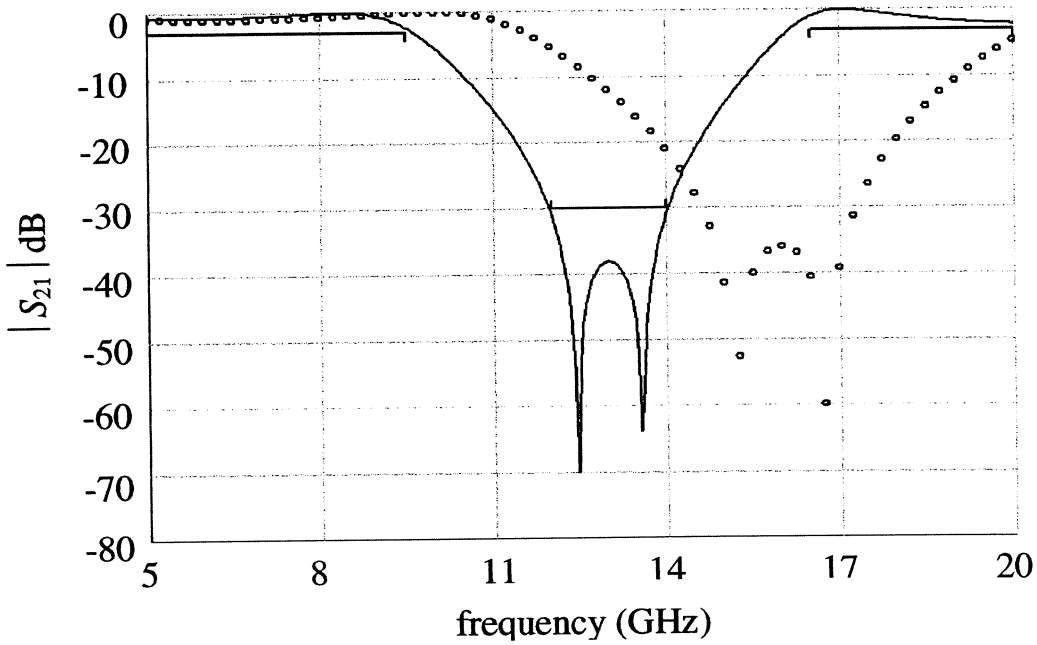
the first phase successfully carried out 8 iterations that required
12 fine model simulations

the first phase reached a local minimum for the SM optimization
and a switch to the second phase took place

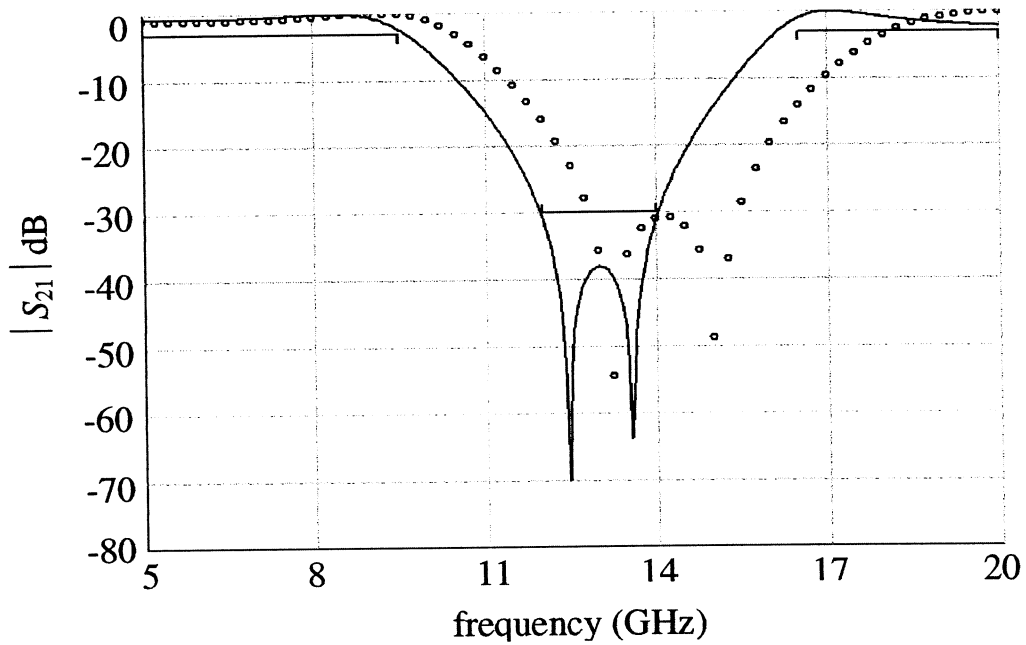
the second phase design is taken as the starting point for the
minimax optimizer



Optimization Results for the DFS Filter



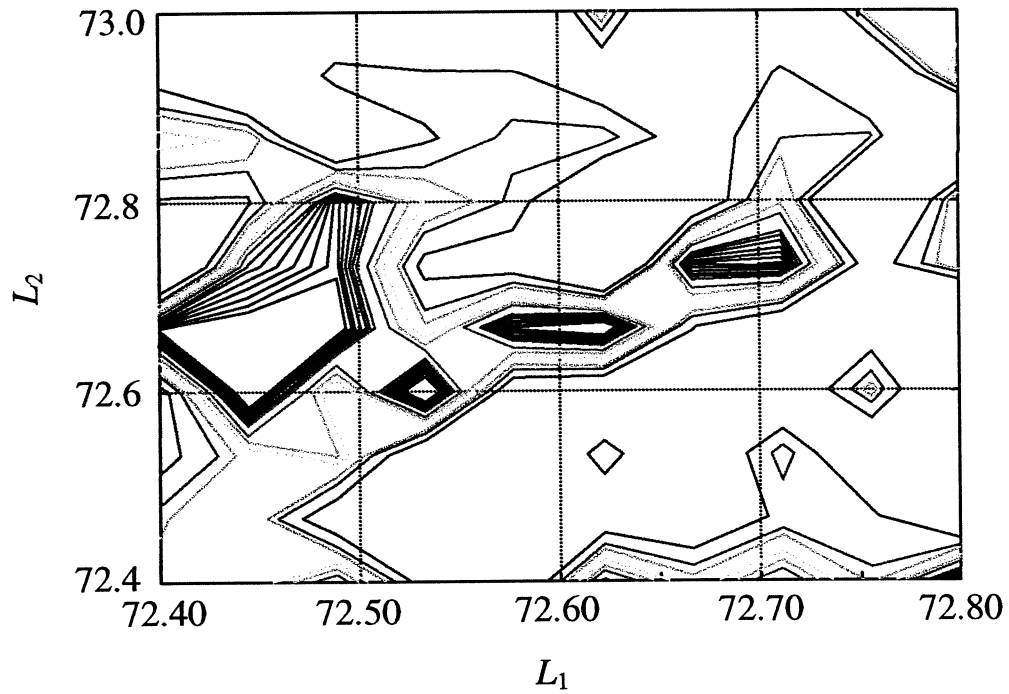
the initial fine model design



the first phase design

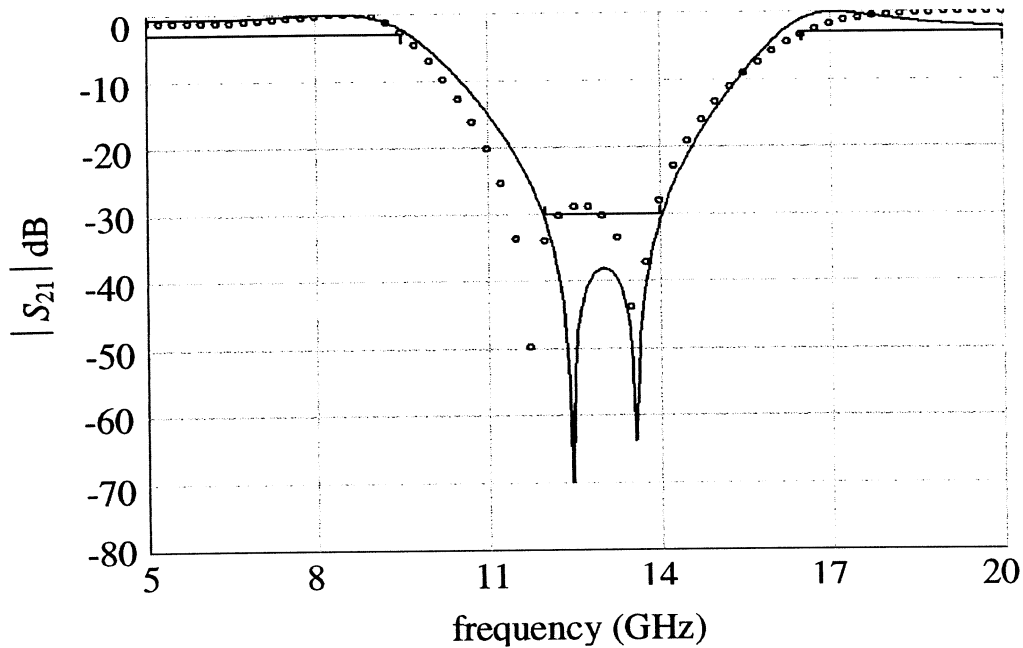


Contours of the Space Mapping Objective Function at the End of the First Phase

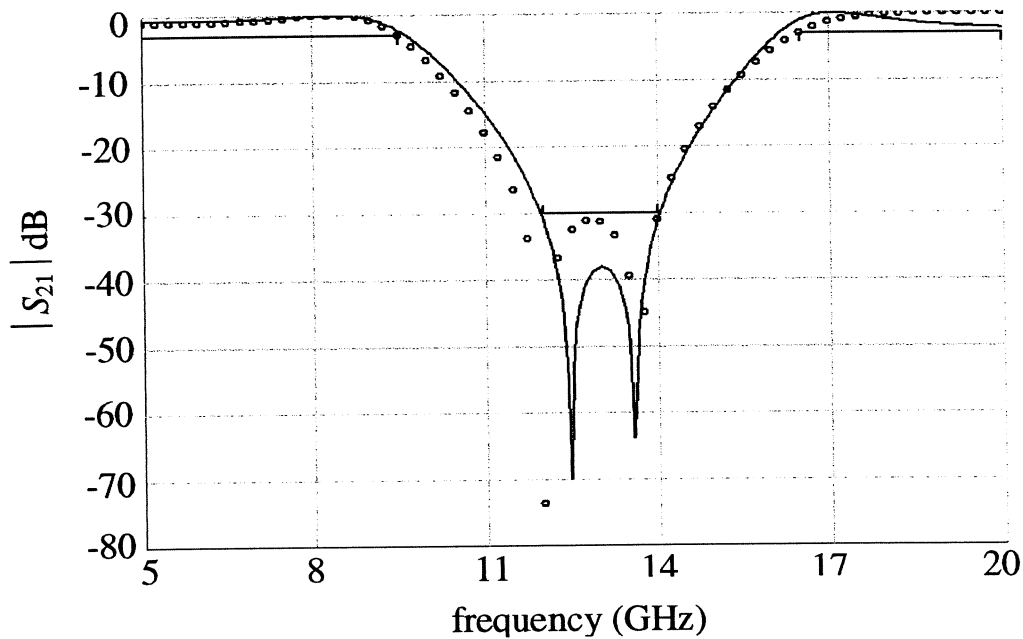




Optimization Results for the DFS Filter



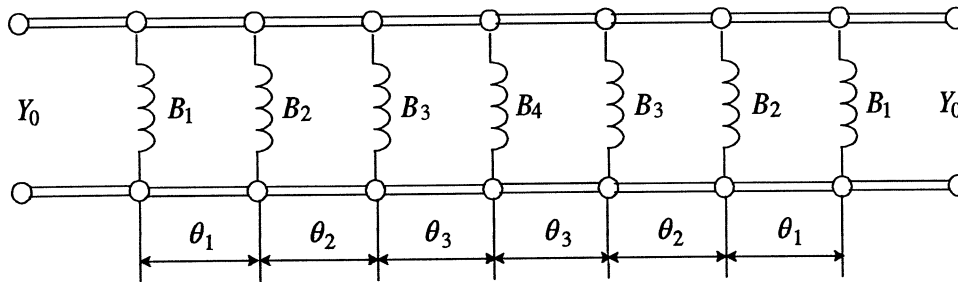
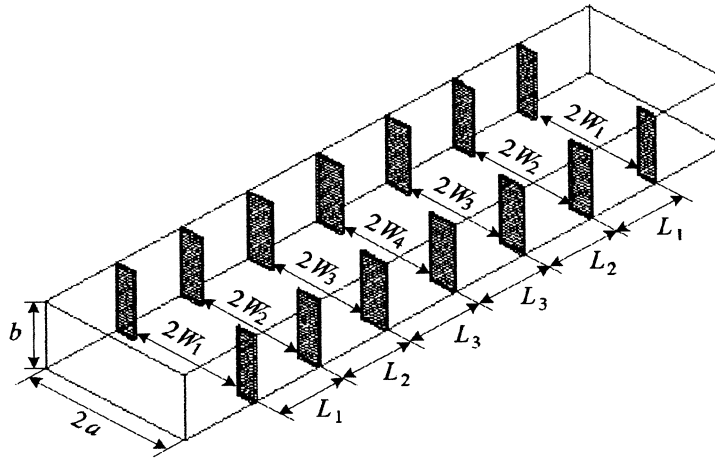
the second phase design



the optimal fine model design



Six-Section H-Plane Waveguide Filter (Matthaei et al., 1964)



design specifications are taken as

$$|S_{11}| \leq 0.16 \text{ for } 5.4 \text{ GHz} \leq f \leq 9.0 \text{ GHz}$$

and

$$|S_{11}| \geq 0.85 \text{ for } f \leq 5.2 \text{ GHz} \text{ and } |S_{11}| \geq 0.5 \text{ for } 9.5 \text{ GHz} \leq f$$

the fine model exploits HP HFSS through HP Empire3D

a waveguide with a cross-section of 1.372 inches by 0.622 inches (3.485 cm by 1.58 cm) is used



Six-Section H-Plane Waveguide Filter

each septum has a finite thickness of 0.02 inches (0.508 mm)

the coarse model consists of lumped inductances and dispersive transmission line sections

a simplified version of a formula (*Marcuvitz, 1951*) is utilized in evaluating the inductances

optimizable parameters are the four septa widths W_1 , W_2 , W_3 and W_4 and the three waveguide-section lengths L_1 , L_2 and L_3

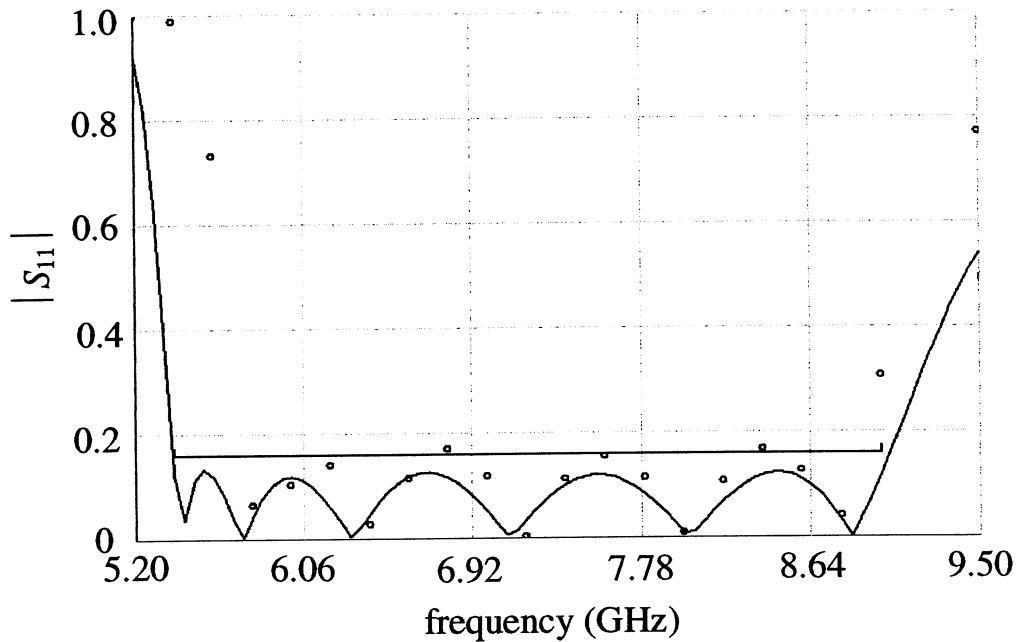
the first phase executed 4 iterations requiring a total of 5 fine model simulations

the second phase did not produce successful iterations

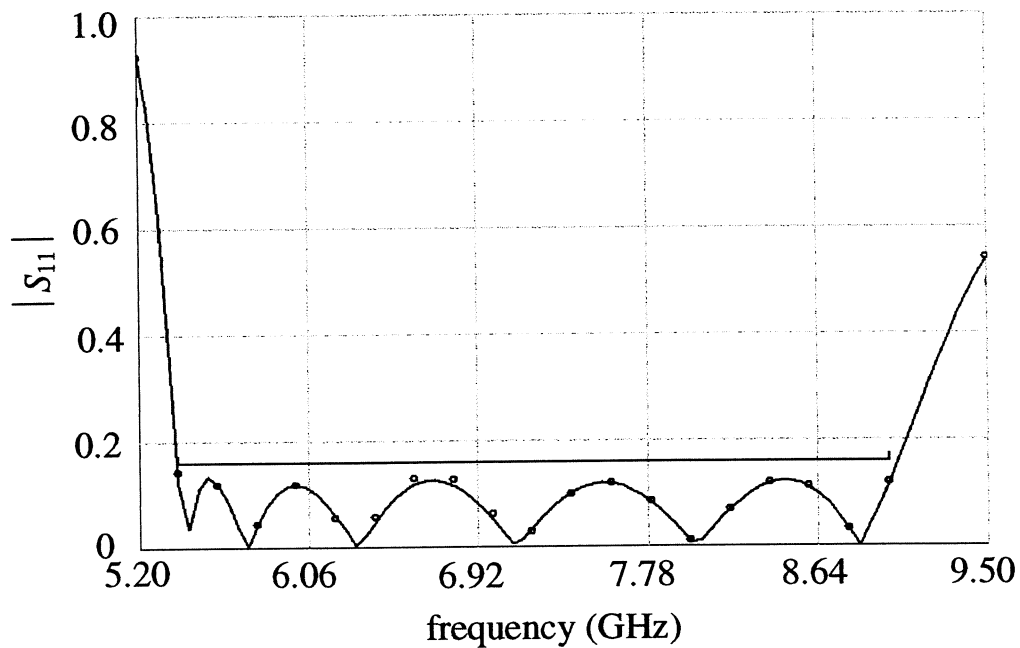
the optimal fine model design is obtained using minimax optimization



Optimization Results for the Six-Section H-Plane Filter



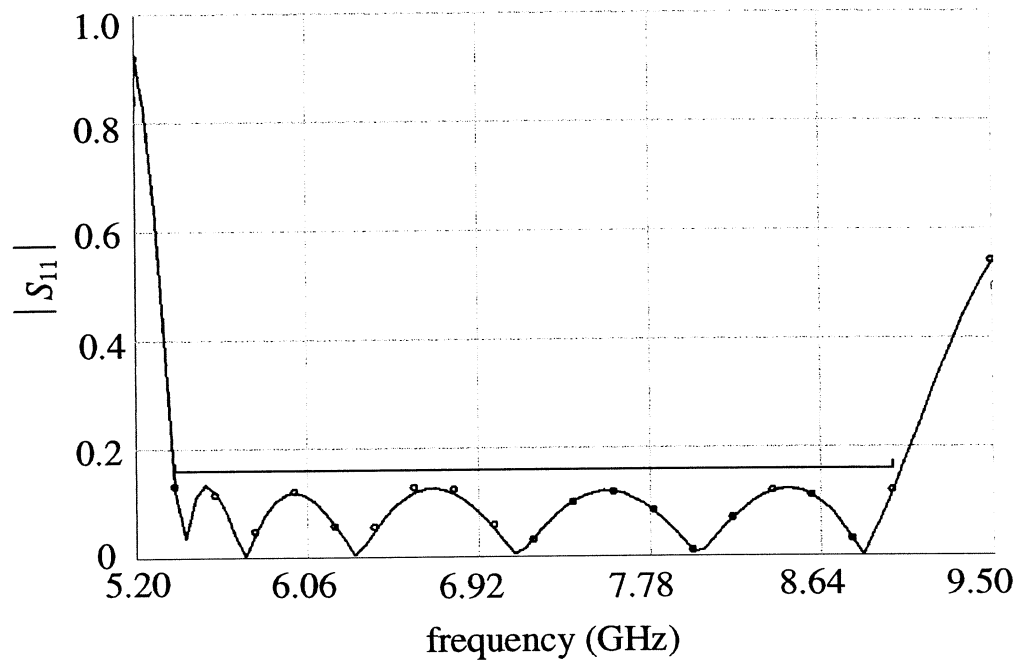
the initial fine model design



the first phase design



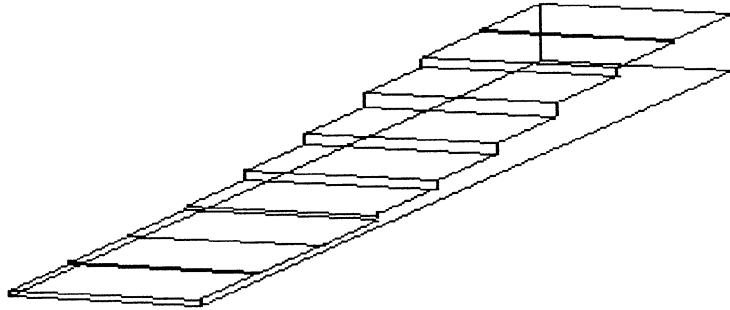
Optimization Results for the Six-Section H-Plane Filter



the optimal fine model design



Seven-Section Waveguide Transformer (Bandler, 1969)



the design specifications are taken as

$$v_{swr} \leq 1.01 \text{ for } 1.06 \text{ GHz} \leq f \leq 1.8 \text{ GHz}$$

the fine model is simulated using HP HFSS through HP Empipe3D

the coarse model is an analytical model which neglects the junction discontinuities

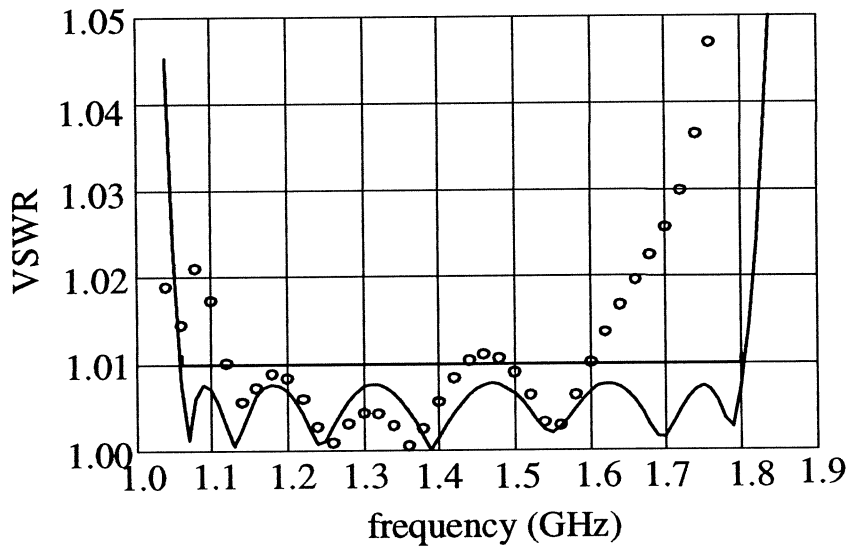
optimizable parameters are the height and length of each waveguide section

the first phase executed 3 successful iterations that required 6 fine model simulations

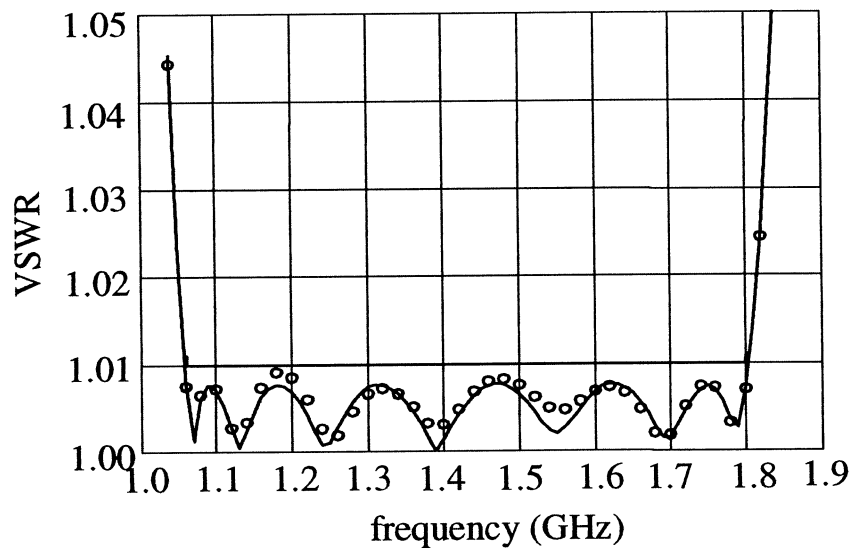
the second phase executed 4 iterations



Optimization Results for the Seven-Section Waveguide Transformer



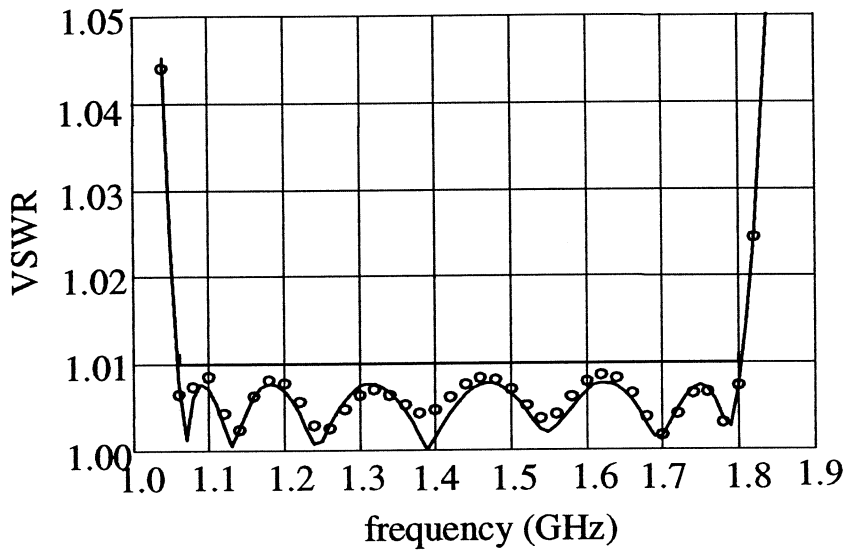
the initial fine model design



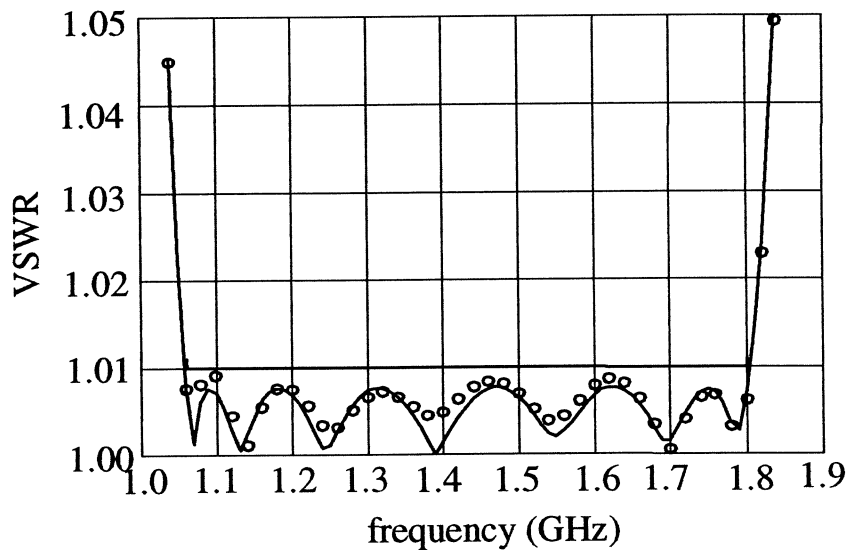
the first phase design



Optimization Results for the Seven-Section Waveguide Transformer



the second phase design



the optimal fine model design

