變阻抗微帶線五環互補式開口共振環用於高靈敏檢測流體之流速與介電系係數

Tapped Impedance Microstrip Line – Penta Complementary Split Ring Resonator (TIM-PCSRR) for High Sensitive Detection of Flow Rate and Permittivity

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無線創新系統電磁應用實驗室
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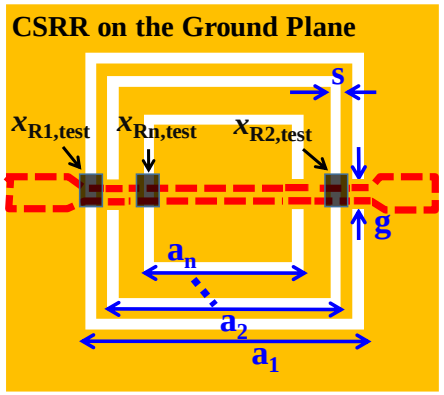
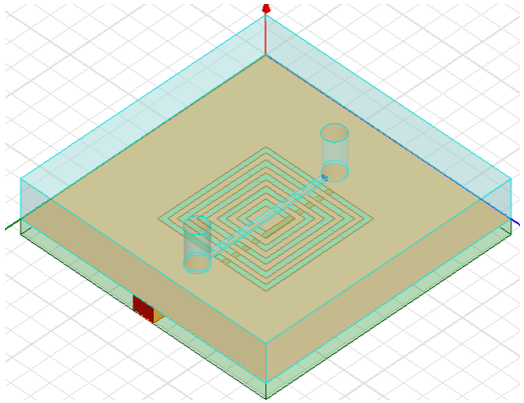
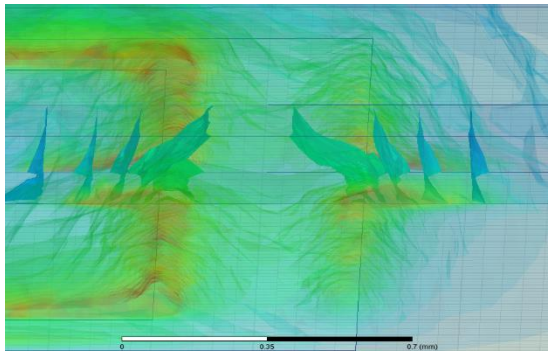
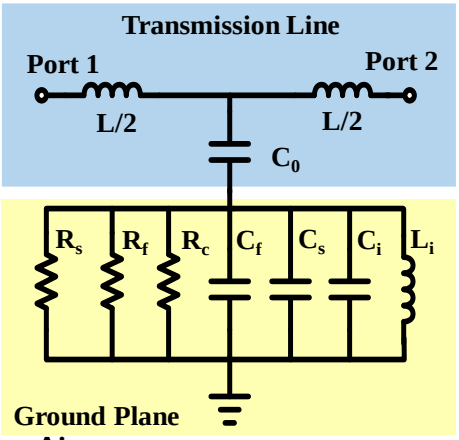
Student : 許家銘 Chia-Ming Hsu

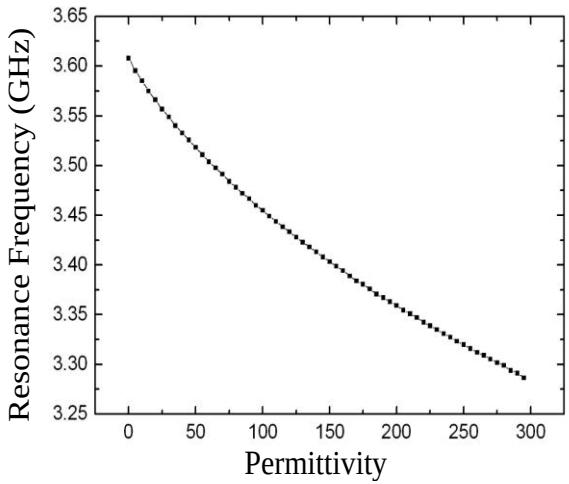
Proposed Method - Planar CSRR Resonator

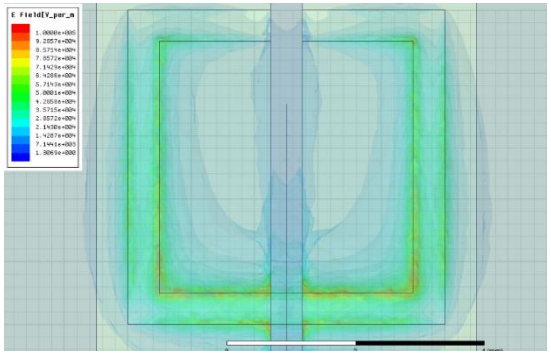


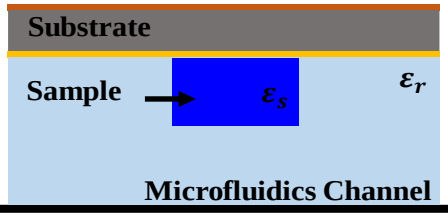




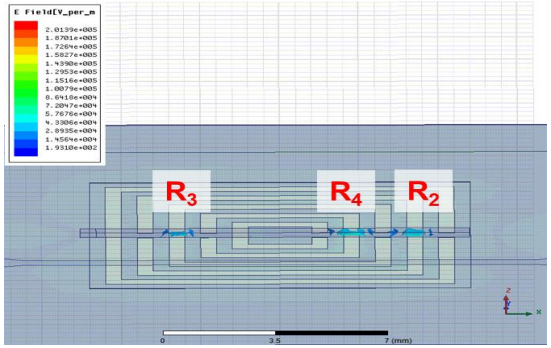




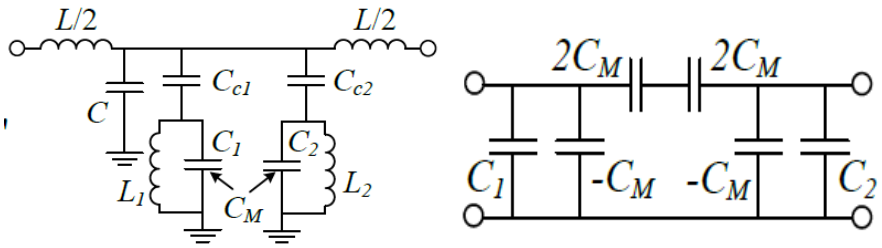




$$f_r = \frac{1}{2\pi\sqrt{L_i(C_i + C_0 + C_f + C_s)}}$$



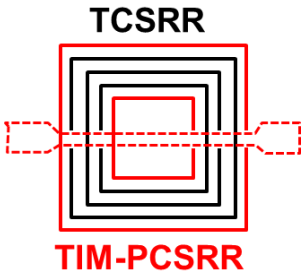
Sensor Design- Mutual Coupling Effect



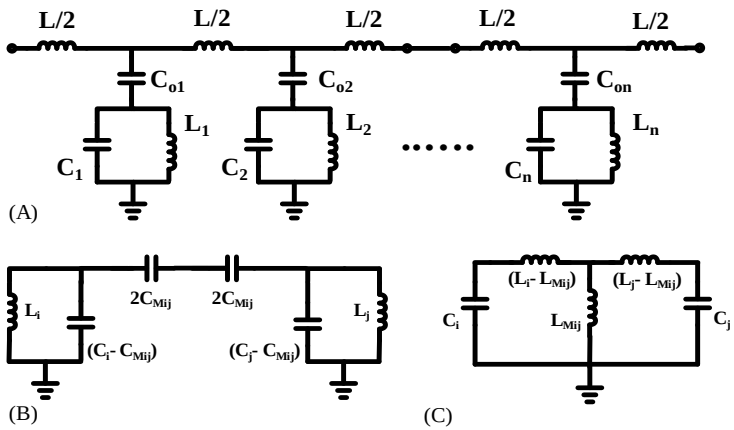
$$\omega_{\pm}^2 = \frac{\omega_i^2+\omega_j^2 \pm \sqrt{(\omega_i^2-\omega_j^2)^2+4C_{ij}^2\omega_i^4\omega_j^4L_iL_j}}{2[1-C_{ij}^2\omega_i^2\omega_j^2L_iL_j]}. \qquad (1)$$

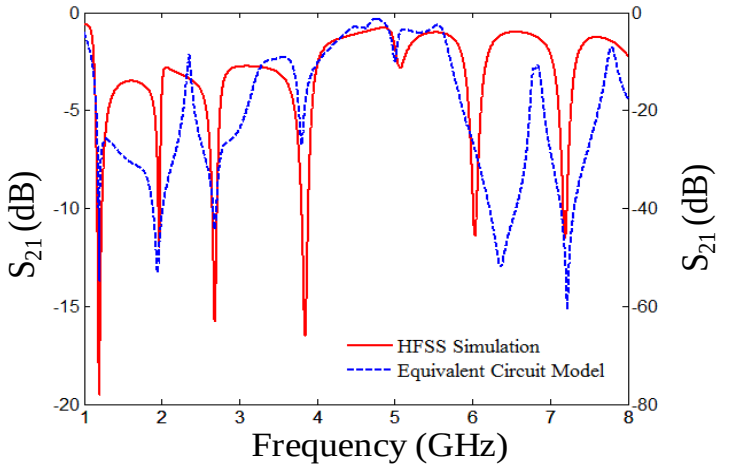
In the case that ($L_i \neq L_j$, $C_i \neq C_j$, $\omega_i \neq \omega_j$)

$$\omega_+^2 - \omega_-^2 = \frac{\sqrt{(\omega_i^2-\omega_j^2)^2+4C_{ij}^2\omega_i^4\omega_j^4L_iL_j}}{[1-C_{ij}^2\omega_i^2\omega_j^2L_iL_j]} > \omega_i^2 - \omega_j^2 \qquad (2)$$



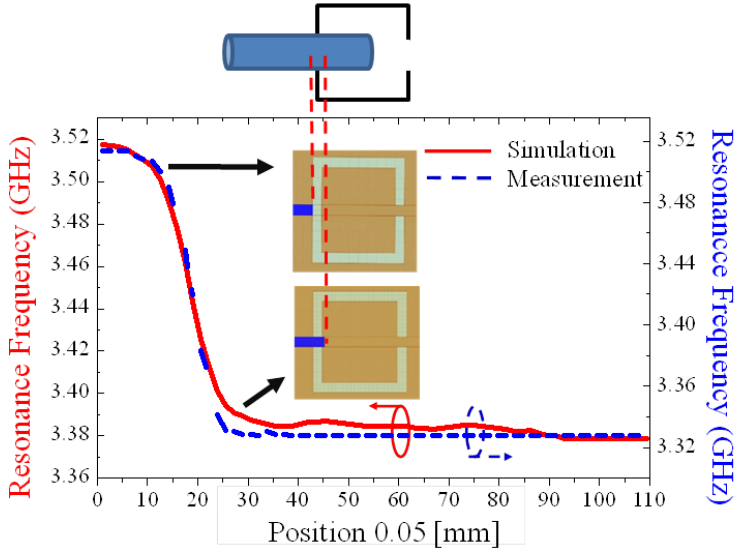
Resonance Frequency (GHz)	TIM-PCSRR	TCSRR [1]
f_1	1.526	1.555
f_2	2.824	2.728
f_3	3.873	4.508
Normalized Sensitivity (%)	TIM-PCSRR	TCSRR [1]
f_1	15.941	12.195
f_2	20.976	16.302
f_3	22.103	15.225

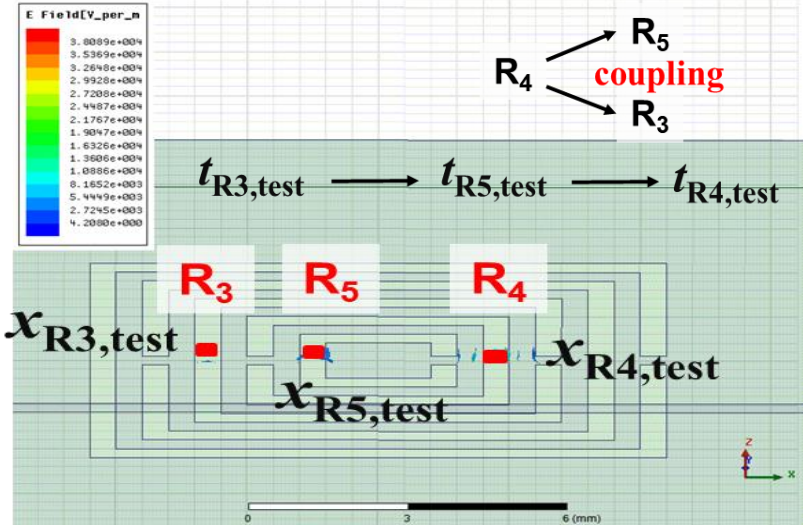


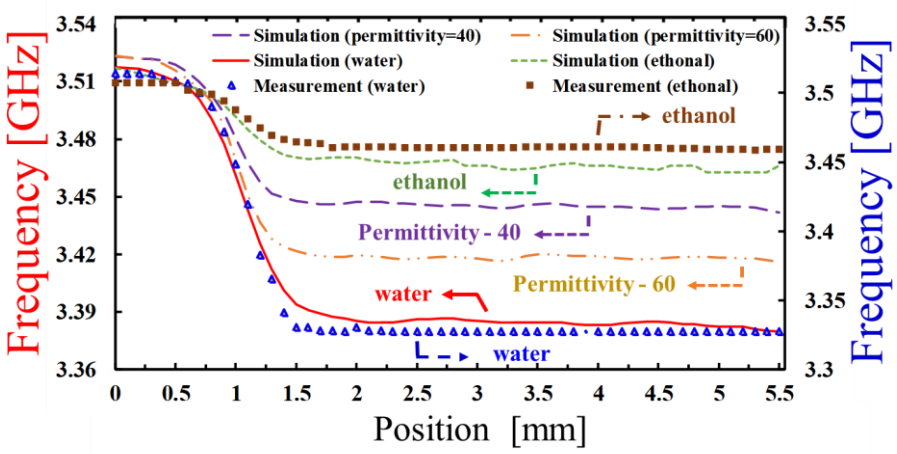


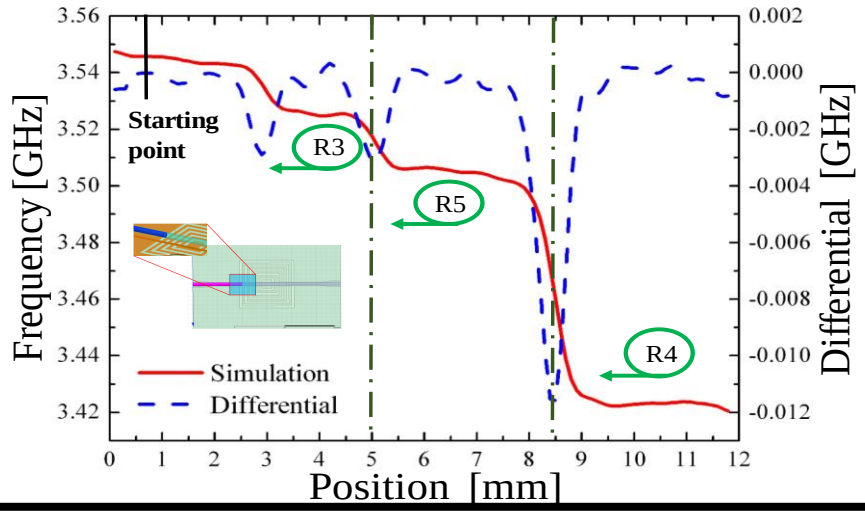
	M_{12}	M_{23}	M_{34}	M_{45}
C_M (pF)	1.3	1.15	0.65	0.1
L_M (nH)	1	0.3	0.1	0.025

Principle (2/3)









Principle (2/3)