Microwave Engineering

The Smith Chart

Pointing Specific Parts on Planes

- WE Wish to plot values from impedance plane to Reflection coefficient plane.
- We Already know that

$$\bar{z} = r + jx = \frac{1+\Gamma}{1-\Gamma}$$

$$r + jx = \frac{1 + u + jv}{1-(u+jv)}$$

- Where u represents real part and V represent imaginary part

Solving Equations

$$\bar{z} = r + jx = \frac{1+\Gamma}{1-\Gamma}$$

$$r + jx = \frac{1 + u + jv}{1 - (u + jv)}$$

- If I solve the following equations and separate values for real and imaginary parts , I will get two equations

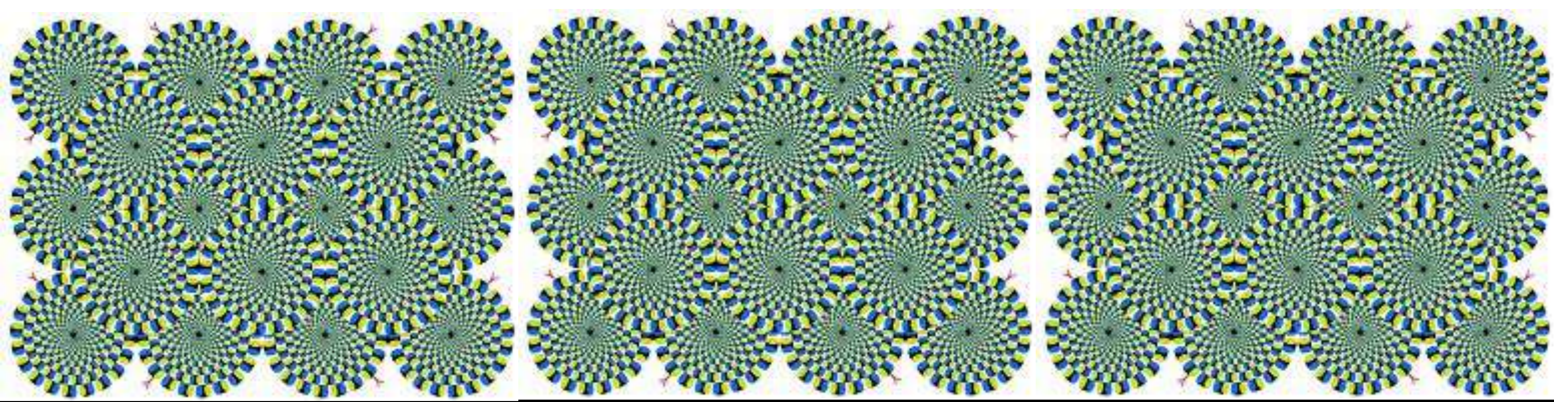
So when I will map my impedances on Gama plane , the equations will give two set of curves , one corresponding to real value r and other corresponding to imaginary value x

Equations

- Constant Resistance Circle

  - $(u^2 - 2)\frac{r}{r+1}(u+v)2+\frac{r-1}{r+1}=0$

- Center $=(\frac{r}{r+1}, 0)$ Radius= $\frac{1}{r+1}$



Constant

- Constant Reactance circle

$$(u^2 + v^2) - 2u - \frac{2}{x}(v+1) = 0$$

Center $= (1, \frac{1}{x})$ Radius $= \frac{1}{x}$

Equations

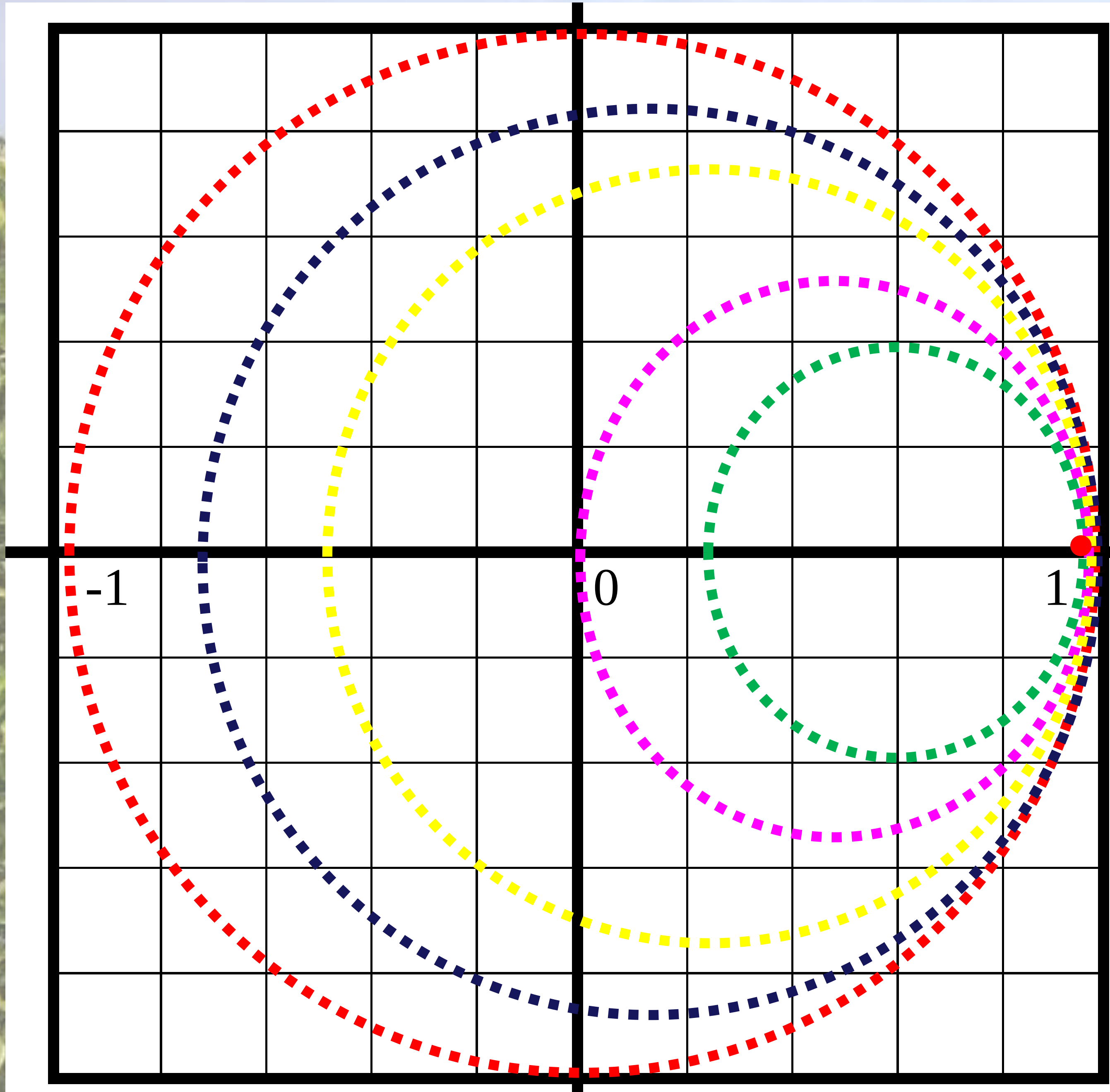
- From equations we observe that both equation represent circle on gamma plane
- For any given value of r I get a circle on given real gamma plane and for any value of x I get a circle on complex gamma plane

Constant Resistance Circle

So if I put values and calculate my real part on complex gamma plane I will get some thing

	Center		Radius
r	r/(r+1)	0	1/(r+1)
0	0	0	1
1	0.5	0	0.5
4	0.8	0	0.2
10	0.909091	0	0.090909
#DIV/0!	#DIV/0!	0	#DIV/0!

- Center $=\left(\frac{r}{r+1}, 0\right)$
- Radius$=\frac{1}{r+1}$



	Center		Radius
r	r/(r+1)	0	1/(r+1)
0	0	0	1
0.25	0.2	0	0.8
0.5	0.333333	0	0.666667
1	0.5	0	0.5
4	0.8	0	0.2
10	0.909091	0	0.090909
#DIV/0!	1	0	0

Constant Reactance circle

- **Constant Reactance circle**

$$(u^2 + v^2) - 2u - \frac{2}{x}(v+1) = 0$$

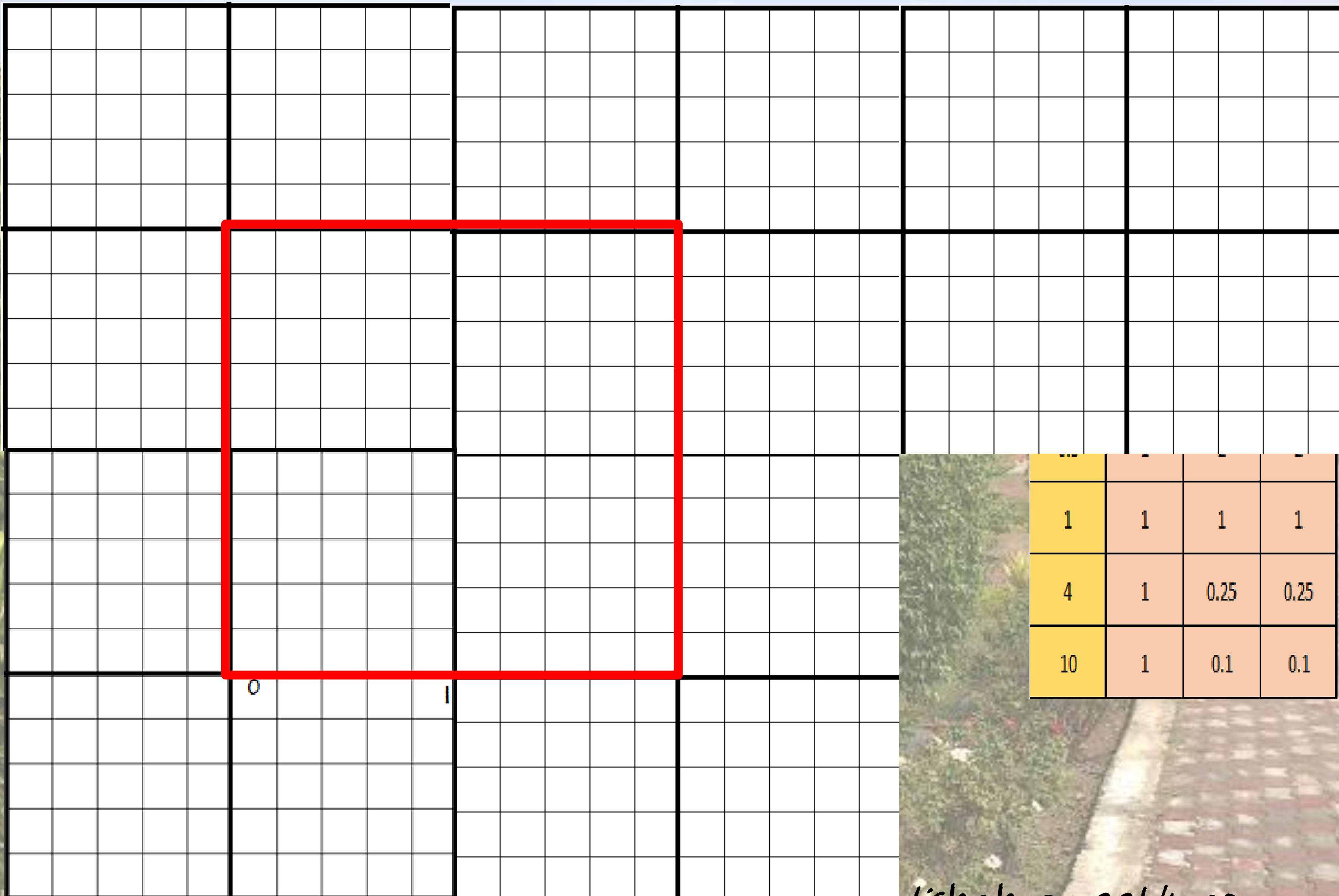
Center $=(1, \frac{1}{x})$ Radius$= \frac{1}{x}$

- Similarly we get another set of circles . Plotting the circles

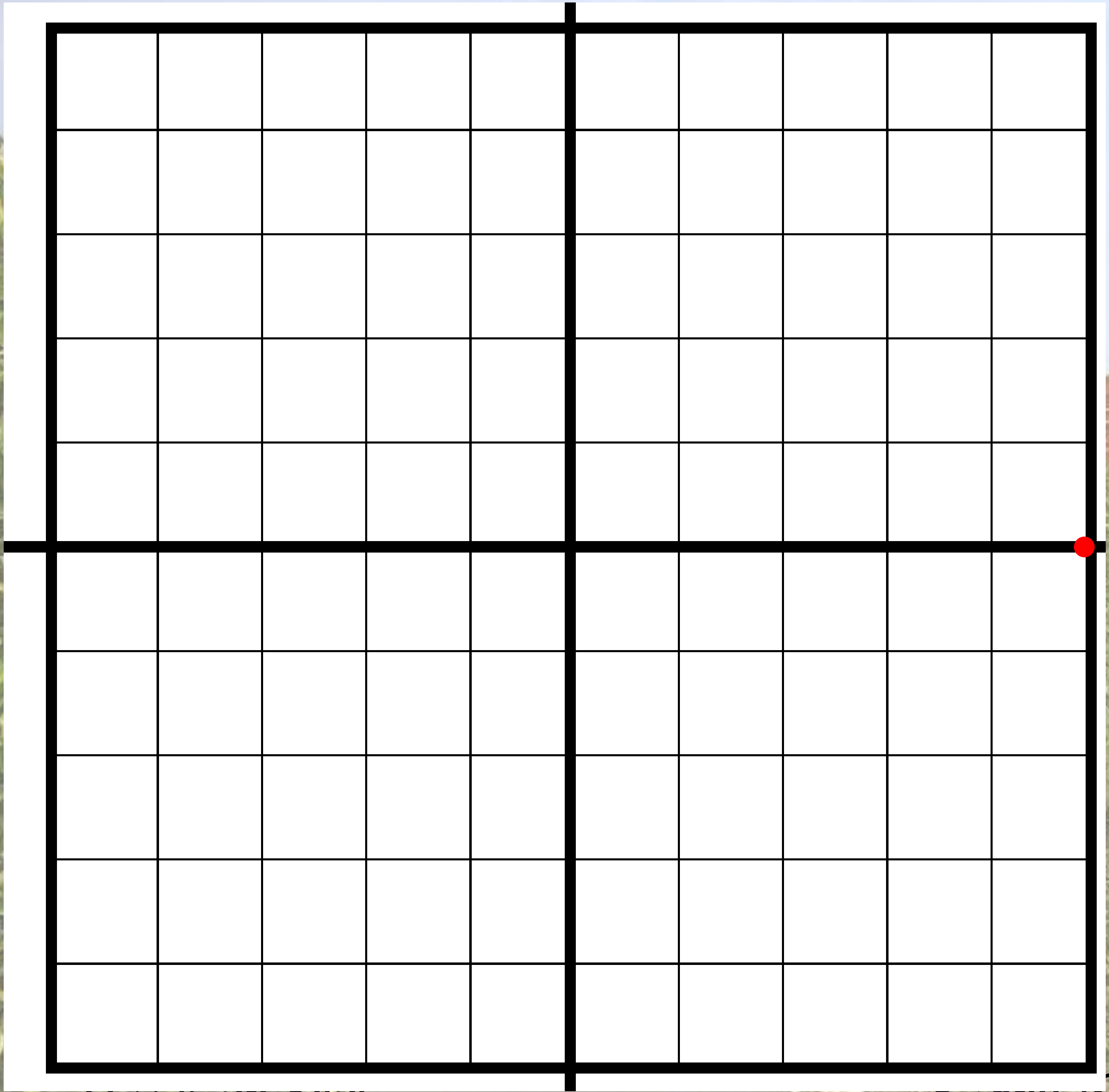
Constant Reactance circle

	Center		Radius
x	1	1/x	1/x
0	1	#DIV/0!	#DIV/0!
0.25	1	4	4
0.5	1	2	2
1	1	1	1
4	1	0.25	0.25
10	1	0.1	0.1

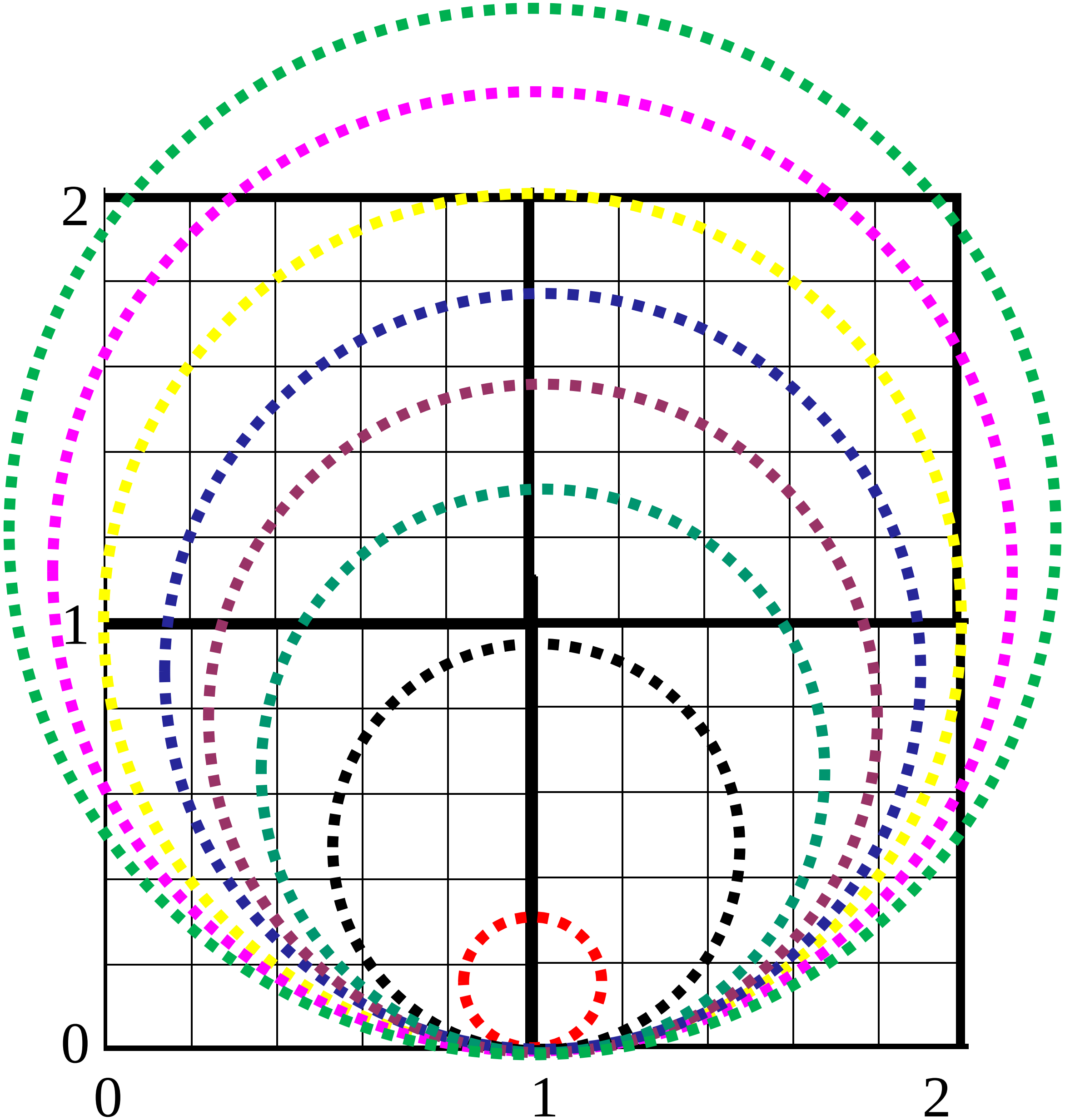
- Center $=(1, \frac{1}{x})$
- Radius$= \frac{1}{x}$



[illegible]	[illegible]	[illegible]	[illegible]
1	1	1	1
4	1	0.25	0.25
10	1	0.1	0.1

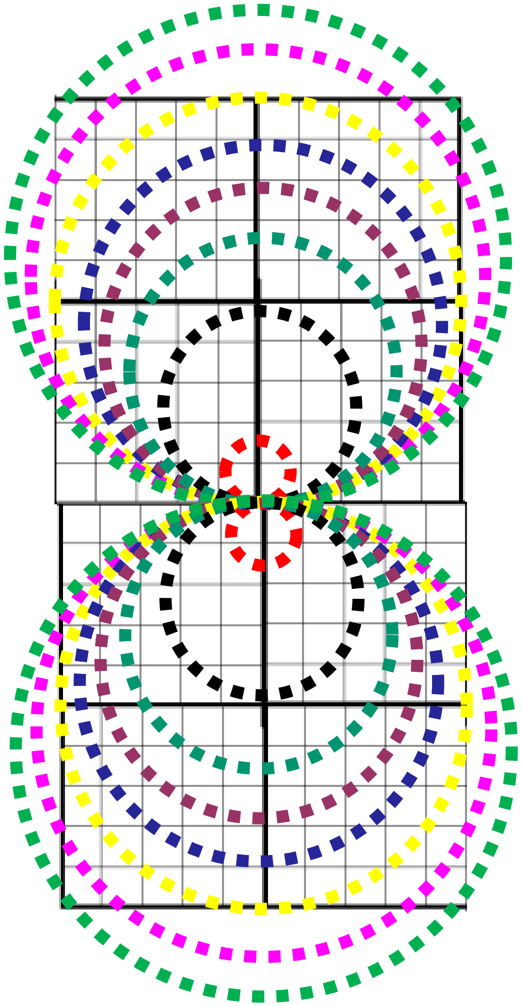


	Center		Radius
x	1	1/x	1/x
0	1	#DIV/0!	#DIV/0!
0.25	1	4	4
0.5	1	2	2
1	1	1	1
4	1	0.25	0.25
10	1	0.1	0.1

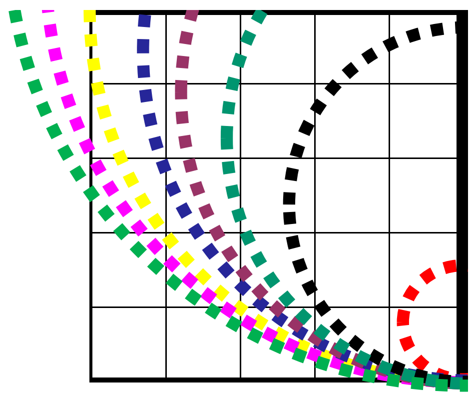


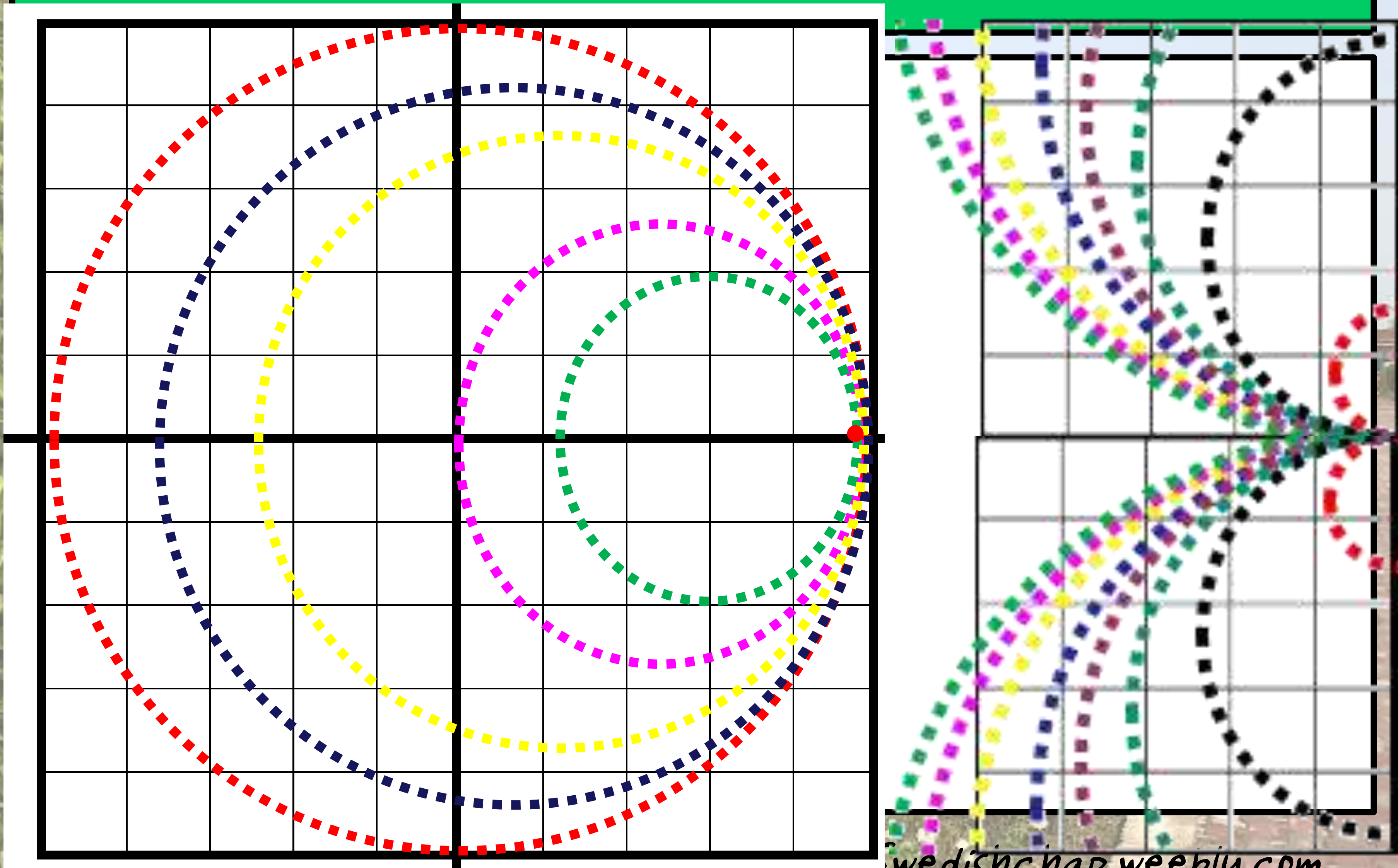
	Center		Radius
x	1	1/x	1/x
0	1	#DIV/0!	#DIV/0!
0.25	1	4	4
0.5	1	2	2
1	1	1	1
4	1	0.25	0.25
10	1	0.1	0.1

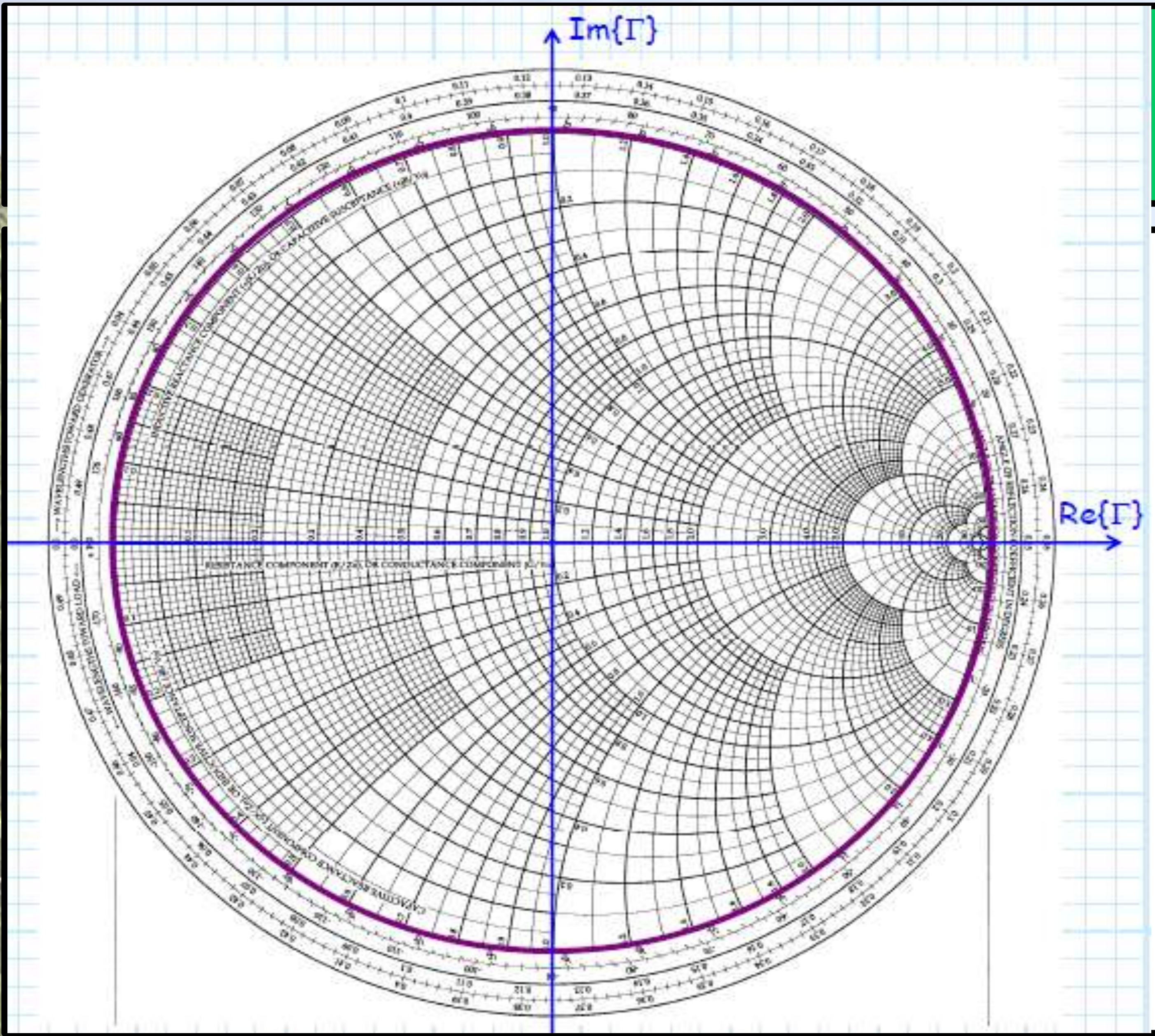
Similarly we can calculate values for negative imaginary values



Choosing area of validity for Reactance circle






Im{Γ}
Re{Γ}