RC values for a Pink Noise Filter

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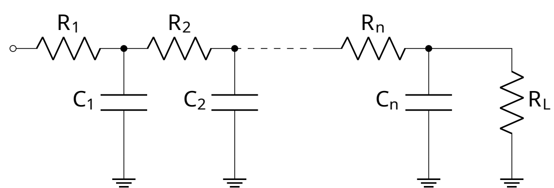
Subjects: engineering, electric circuit, filter, resistance, capacitance, noise
Dec 23, 2023

In our *Creating Noise* book we show how to use RC ladder networks to create pink noise. An n^{th} order network is shown below.



The R and C values are given by the following (equations 37 and 38 in the book).

$$C(n,i) = \frac{4i-1}{(2(n-i)+1)16^i} \frac{\binom{2(n+i)}{n+i}}{\binom{2(n-i)}{n-i}}$$

$$R(n,i) = \frac{(4i-3)(2(n-i)+1)16^i}{4(n-i+1)(n+i)} \frac{\binom{2(n-i)}{n-i}}{\binom{2(n+i)}{n+i}}$$

Using these equations is a bit cumbersome so here are some asymptotic versions of the equations which will go into the next edition of the book.

$$C(n,i) = \frac{4i-1}{(2(n-i)+1)} \sqrt{\frac{n-i}{n+i}}$$

$$R(n,i) = \frac{(4i-3)(2(n-i)+1)}{4(n-i+1)\sqrt{(n+i)(n-i)}}$$

$$C(n,i)R(n,i) = \frac{(4i-1)(4i-3)}{4(n-i+1)(n+i)}$$

These equations obviously only work for $i < n$. For $i = n$ the asymptotic equations are

$$C(n,n) = \frac{4n-1}{\sqrt{2\pi n}}$$

$$R(n,n) = \frac{(4n-3)\sqrt{2\pi n}}{8n}$$

The last resistor in the chain has the asymptotic formula

$$R_L(n) = \sqrt{2\pi n}$$

In the limit $n \to \infty$ with $i/n \to x$ both the R and C equations have the following form

$$\frac{2x}{\sqrt{1-x^2}}$$

where x has the range $0 < x < 1$. In this limit the ladder becomes a continuous transmission line and the total capacitance or resistance (measured from the beginning of the line) is found by integrating the above equation

$$C(x) = R(x) = 2\left(1 - \sqrt{1-x^2}\right)$$