Transfer functions in the s-plane

Hendrik Wade Bode

Hendrik Wade Bode was born in Madison, Wisconsin (USA) on December 24, 1905. Young Hendrik rapidly advanced through elementary and secondary schools and graduated from high school at the age of 14. Although Henrik applied to attend the University of Illinois, he was not accepted because of his young age. However, Ohio State University accepted him where he received his B.A. and M.A. degree in Mathematics in 1926.

Soon after graduating, Bode began an illustrious engineering and scientific research career at Bell Labs where he initially designed electronic filters and equalizers but was subsequently assigned to the Mathematical Research Group. While at Bell Labs, Bode successfully completed his PhD in physics at Columbia in 1935.

In 1938, Dr. Bode invented what is famously known today by engineering students as "Bode plots" for his namesake. But that's not what he called them. He simply called them "asymptotic frequency-domain magnitude and phase plots."

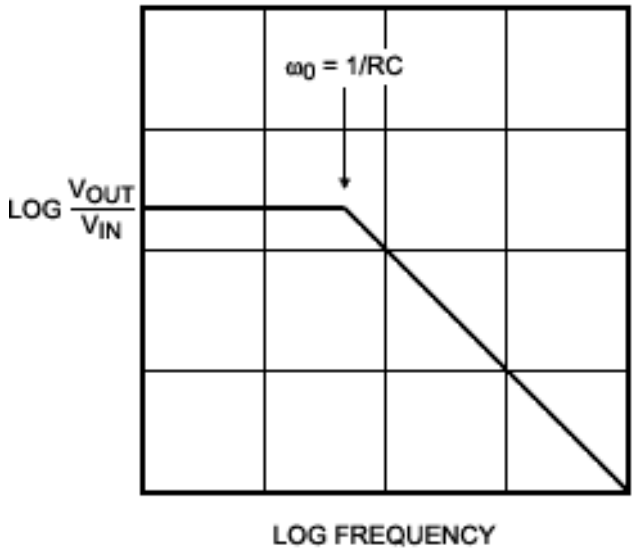
During his time at Bell Labs, Dr. Bode received numerous academic medals and awards and held 25 patents in various areas of electrical and communications engineering. He also collaborated closely with other well-known scientists and researchers at Bell Labs, including Claude Shannon and Harry Nyquist.

Dr. Bode retired from Bell Labs in 1967 and soon after accepted a professorship position at Harvard University where he taught and directed graduate engineering students in Systems Engineering.

During his spare time, Bode enjoyed reading, writing, gardening and sailing. He died on June 21, 1982, at the age of 76 at his home in Cambridge, Massachusetts.

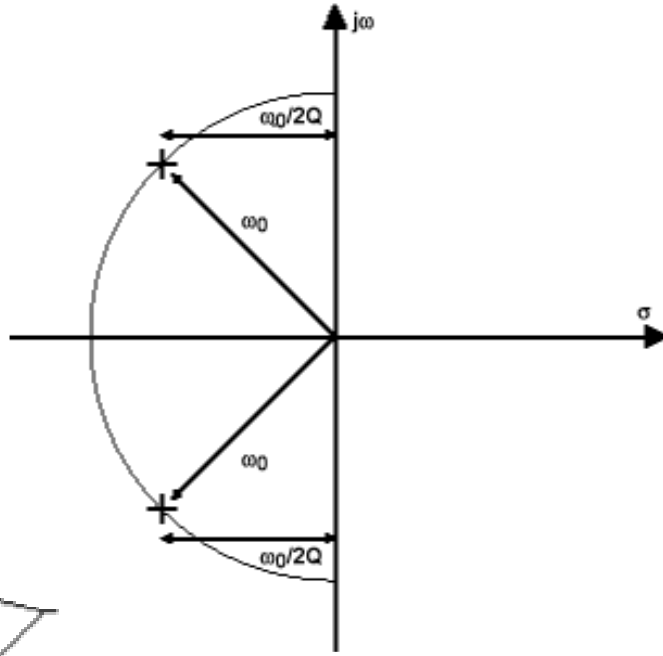
Single-pole transfer function

$$T(s) = \frac{V_{out}}{V_{in}} = \frac{1}{1 + s\tau}$$

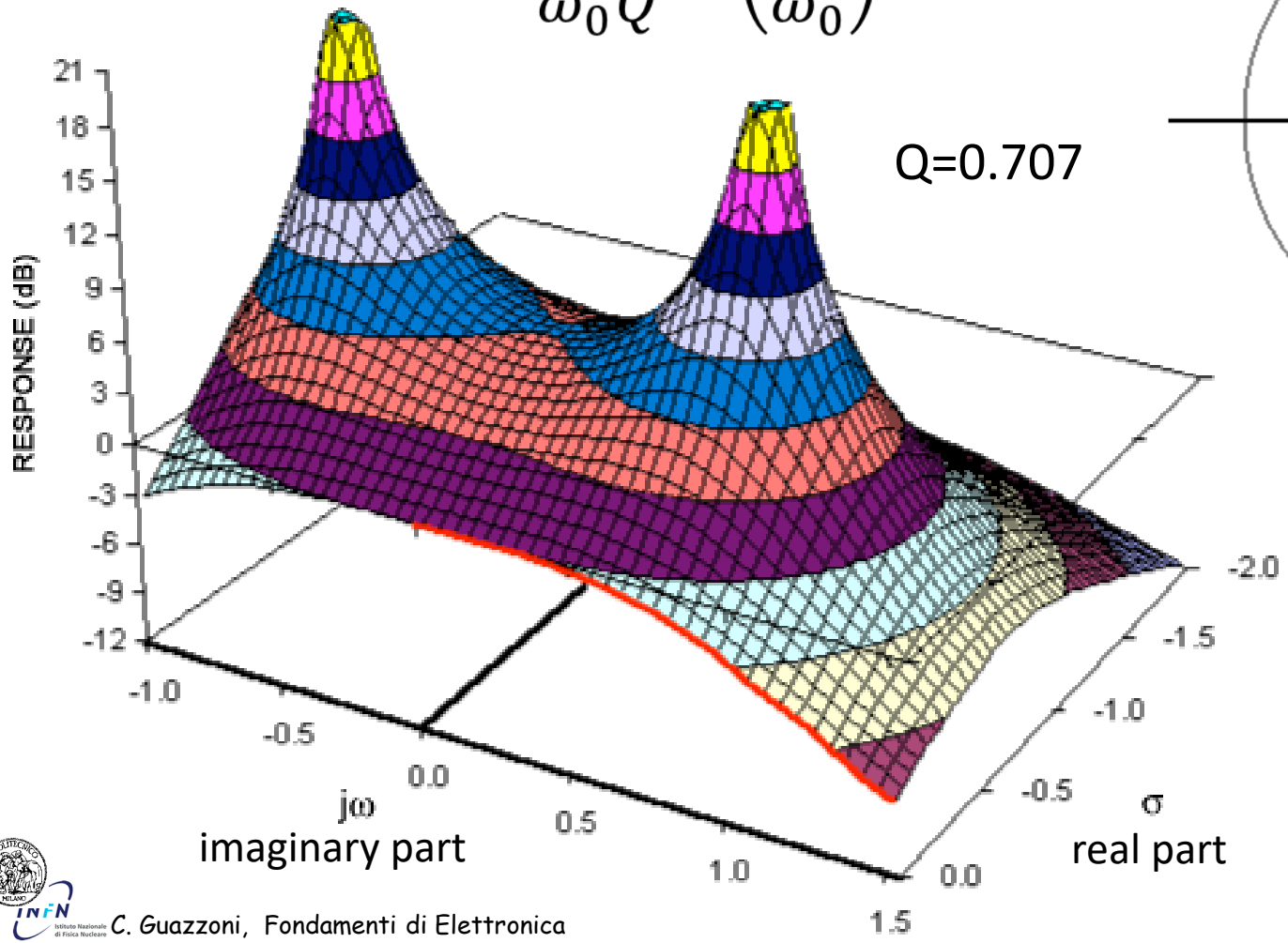


Two-pole transfer function

$$T(s) = \frac{V_{out}}{V_{in}} = \frac{1}{1 + \frac{s}{\omega_0 Q} + \left(\frac{s}{\omega_0}\right)^2}$$

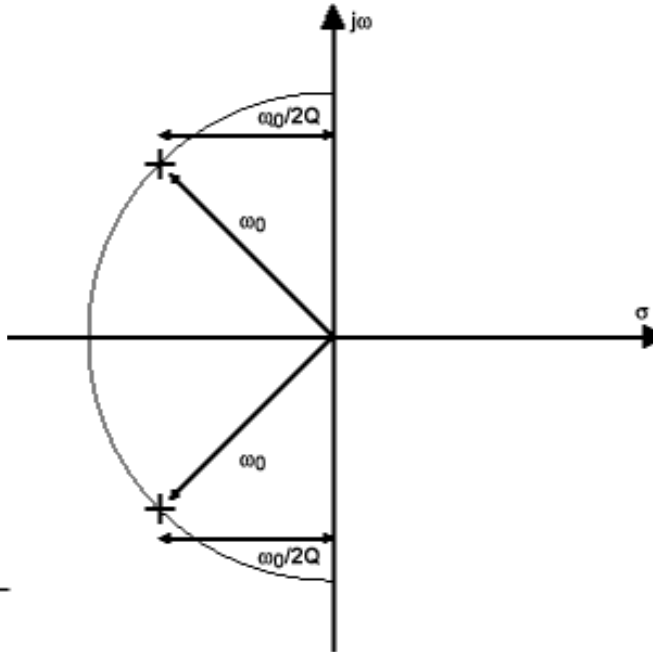


Q=0.707

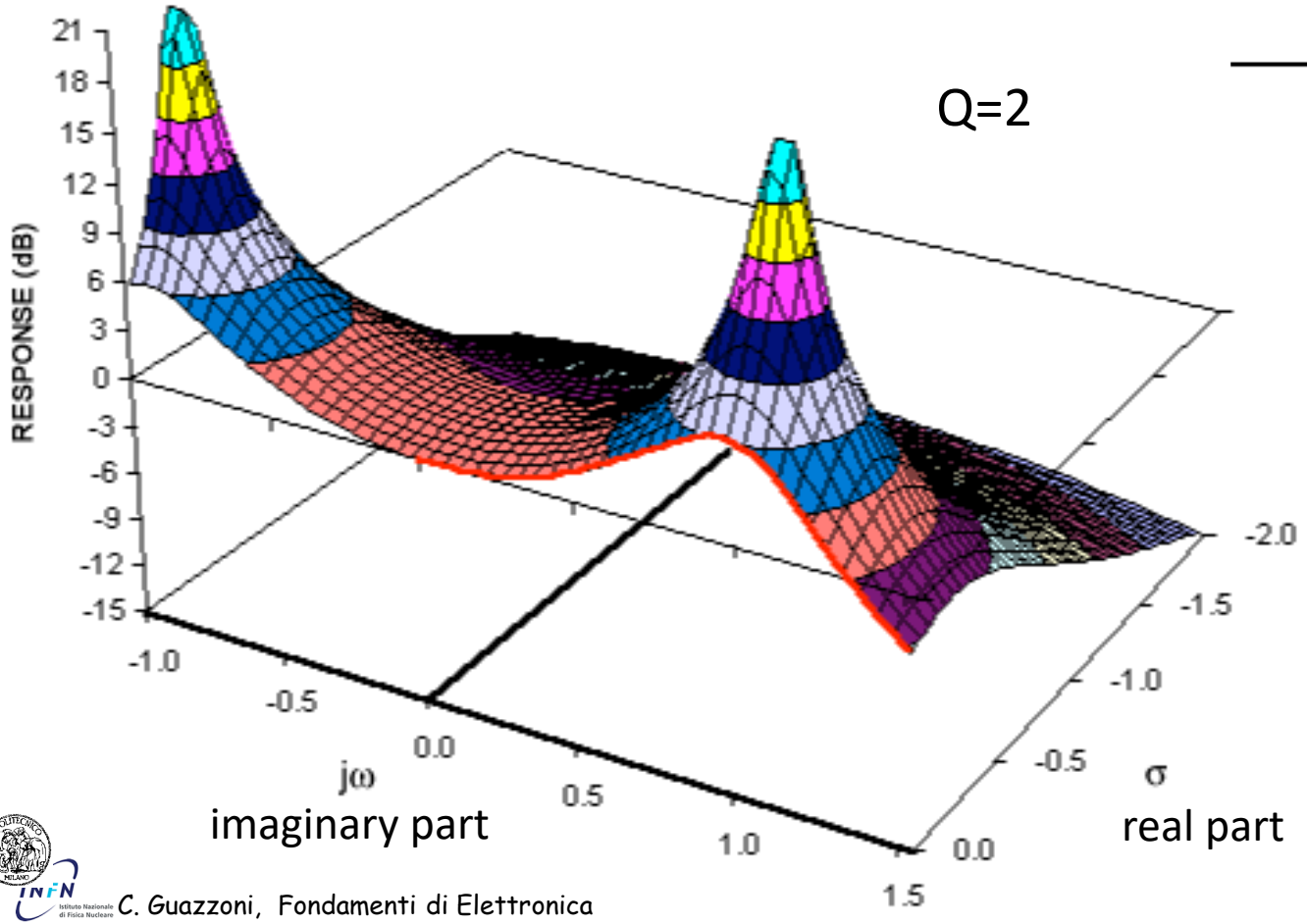


Two-pole transfer function

$$T(s)=\frac{V_{out}}{V_{in}} = \frac{1}{1+\frac{s}{\omega_0 Q}+\left(\frac{s}{\omega_0}\right)^2}$$

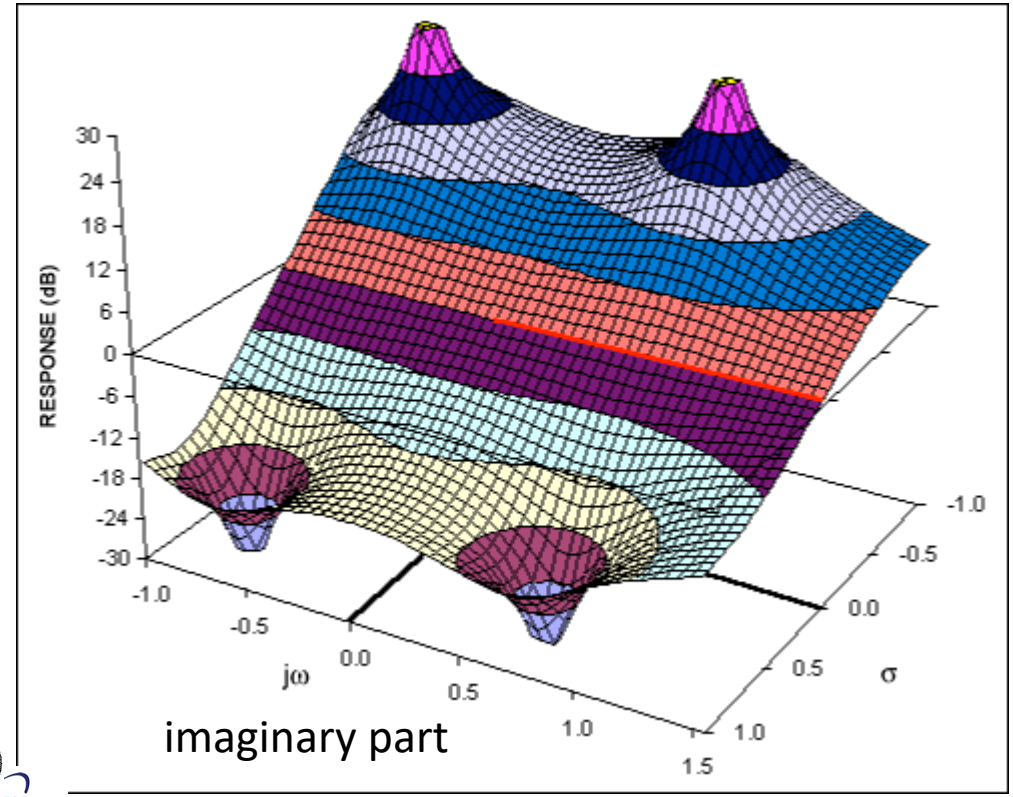


Q=2

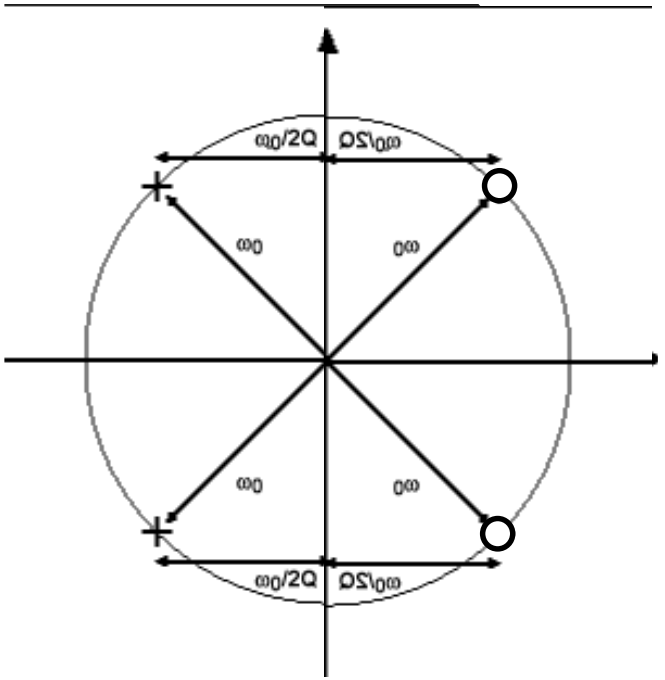


Two-pole, two-zero transfer function

$$T(s) = \frac{V_{out}}{V_{in}} = \frac{1 - \frac{s}{\omega_0 Q} + \left(\frac{s}{\omega_0}\right)^2}{1 + \frac{s}{\omega_0 Q} + \left(\frac{s}{\omega_0}\right)^2}$$



imaginary part



real part