

Analyzing the Response of an RLC Circuit

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Abstract- RLC circuit response and analysis is modelled using MATLAB. We calculate the stability of system using bode plot method. Bode plot is one of the convenient method for stability calculation since using it we not only calculate stability but also phase margin ,gain margin, phase crossover frequency, gain crossover frequency at a time. The response of RLC is examined from different input form using MATLAB.

Index Terms- RLC, Response ,System order, BIBO, GUI

I. INTRODUCTION

An RLC circuit (also known as a Resonant circuit or a tuned circuit) is an electrical circuit consisting of a resistor (R), an inductor (L), and capacitor (C), connected in series or in parallel. An RLC circuit is called a *second-order* circuit as any voltage or current in the circuit can be described by a second-order differential equation for circuit analysis. One very useful characterization of a linear RLC circuit is given by its Transfer Function, which is (more or less) the frequency domain equivalent of the time domain input-output relation.

We use MATLAB for analyzing the frequency response of the circuit, time response of the circuit. To analyse other standard circuit configurations such as low pass and high pass RLC network, we use interactive GUI. In GUI you can change the RLC parameter and see the effect on the time and frequency response in real time.

II. TIME RESPONSE

The **time response** represents how the state of a dynamic system changes in time when subjected to a particular input. The time response of a control system is divide into two parts (a)transient response (b)steady state response. The transient response is the part of the response which goes to zero as the time increases and steady state response is the part of the total response after transient has died. MATLAB provides many useful resources for calculating time responses for many types of inputs.

III. FREQUENCY RESPONSE

In LTI systems, if the input to the system is sinusoidal, then the steady-state output will also be sinusoidal at the same frequency but in general with different magnitude and phase. These magnitude and phase differences as a function of frequency comprise the **frequency response** of the system. The frequency response of a system can be found from the transfer function in the following way: create a vector of frequencies (varying between zero or "DC" to infinity) and compute the value of the plant transfer function at those frequencies.

IV. STABILITY

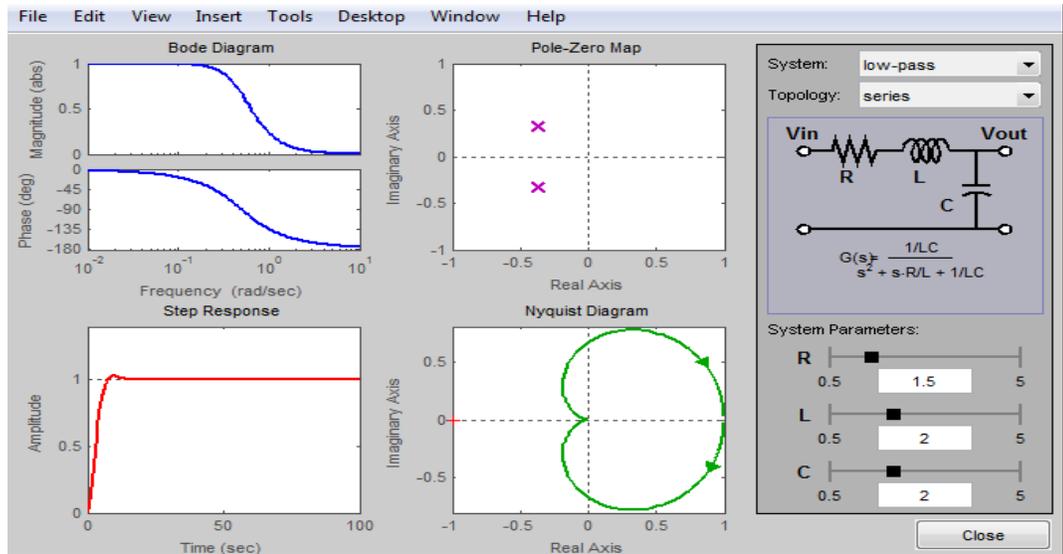
We use the **Bounded Input Bounded Output (BIBO)** definition of stability which states that a system is stable if the output remains bounded for all bounded (finite) inputs. We use transfer function representation to analyse stability. If all poles of the transfer function (values of s at which the denominator equals zero) have negative real parts, then the system is stable. If any pole has a positive real part, then the system is unstable. If we view the poles on the complex s -plane, then all poles must be in the left half plane (LHP) to ensure stability. If any pair of poles is on the imaginary axis, then the system is marginally stable and the system will oscillate.

V. SYSTEM ORDER

The order of a dynamic system is the order of the highest derivative of its governing differential equation. It is the highest power of s in the denominator of its transfer function. Based on power of s we have first order, second order and highest order system.

VI. RESULT

To analyze other standard circuit configurations such as low-pass and high-pass RLC networks, series and parallel networks, we use an interactive GUI. In this GUI, you can change the R, L, C parameters and see the effect on the time and frequency responses in real time.



VII. SOFTWARE USED

Here we are using MATLAB software. The version we are using is 7.10.0.499(R2010a). MATLAB is a software package for high performance computation and visualization. The combination of analysis capabilities, flexibilities, reliability and powerful graphics makes MATLAB the premier software package for engineers and scientists. MATLAB provides an iterative environment with more than hundreds of reliable and accurate built-in mathematical functions. These functions provide solutions to a broad range of mathematical problems including: Matrix Algebra, Complex Arithmetic, Linear Systems, Differential Equations, Signal Processing, Optimization and other types of scientific computations . In this paper, the need for MATLAB as a pedagogical tool in engineering research and teaching is highlighted.

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