what is Nyquist plot ?

A Nyquist plot is graphical

1) what is Nyquist plot ?

A Nyquist plot is graphical representation used to analyze the stability of a system in frequency domine. It is typically a plot of complex function $G(j\omega)$, where G is the system's transfer function and ω is the frequency variable. The plot is created by varying the frequency ω over a range and plotting the real and imaginary parts of $G(j\omega)$ as the frequency varies.

2) why do we use Nyquist plot ?

* Stability Analysis :- One of the primary purpose of nyquist plots is to assess the stability of control system. By examining how the nyquist plot encircles the critical points in complex plane, engineers can determine if the system is stable.

* Performance :- It is measured by parameters such as gain margin, phase margin, bandwidth.

* Robustness Analysis :- It refers to ability of control system to perform effectively in the presences of uncertainties & disturbances.

* Model Validation :- Nyquist plot can also be used to validate mathematical models of control system. By comparing experimental nyquist plot with theoritical predictions, engineers can verify the

accuracy of their models & identify any discrepancies that may require further investigation.

3) where do we use nyquist plots?

A) * Aerospace systems
* Automotive control system
* Power system.
* Industrial automations
* Telecommunications
* Renewable energy system.
* Filter Design
* Feedback control
* signal integrity.

4) How nyquist plot works?

A) * system Transfer function :- The transfer function relates the i/p to o/p of the system in the laplace domain. It typically takes the form of a ratio of polynomial in laplace variable 's', representing the system's dynamics.

* Frequency Response :- The nyquist plot involves evaluating the transfer function at various points in complex plane for different frequencies. This provides insight into how the system responds to sinusoidal i/p to different frequencies

* Mapping complex plane :- For each frequency ω, the T.F $G(s)$ is evaluated at $s = j\omega$, where j is the imaginary unit. This results in a complex no $G(j\omega)$, representing the magnitude & phase of the s/m response at the frequency.

* Plotting :- The nyquist plot is created by plotting the real part (magnitude) of $G(j\omega)$ on x-axis & imaginary phase (phase) on y-axis as ω varies. Each point on the nyquist plot represents the system's response at a specific frequency.

* Stability Analysis :- The nyquist plot is used to assess the stability of the system. By analyzing whether the plot encircles the critical point $-1+j0$ in complex plane. The direction & no. of encirclement provides info. abt s/m stability. If the plot ~~is~~ encircles it clockwise, the s/m is unstable.

* Gain & phase Margin :- Nyquist plot also provides information about the gain and phase margin of the s/m. The distance b/w the plot & critical point indicates the gain margin, which represents the amount by which the s/m critical gain can be increased before instability occurs. The phase margin is related to phase difference b/w the s/m o/p & i/p signal & provides insight into the s/m stability robustness.

Related hardware :-

* Signal Generator :- Signal generator are used to produce sinusoidal i/p signal of varying frequencies. These signals are applied to control s/m under analysis to measure its frequency response.

* Sensors :- It is used to measure the response of control system to i/p signals.

Algorithm :-

Input :- $G(s)\,H(s) = \frac{k}{(s+1)(s+2)}$.

1). $s = j\omega$, $\omega = 0$ to ∞
find magnitude, phase.

2) $\lim_{R \to \infty} s = Re^{j\theta}$.

3) $s = -j\omega$.

4) $\lim_{r \to 0} s = re^{j\theta}$.

$Z = P + N$.

Teacher's Signature : ....

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