Study questions FRTN35

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- How do you sketch (by hand) the Bode diagram for the following transfer functions
$$\frac{1}{s+1} \qquad \frac{\omega^2}{s^2+2\zeta\omega s+\omega^2} \qquad \frac{1}{s^2}$$
- How does a transfer function relate to the physics of a process?
- In the following model, explain a possible physical origin of the A, B and C polynomials
$$A(z)Y(z) = B(z)U(z) + C(z)U(z)$$
- How does the impulse response relate to the transfer function of a process?
- Reason about the spectrum of an impulse response to determine why it might be useful to describe the behavior of a linear process.
- What is the relation between a covariance function and a power spectrum?
- What is the relation between the Laplace transform and the z-transform? How do you evaluate the frequency response of a transfer function given in the Laplace domain and z-domain respectively.
- How do you go from a state-space model of a system to a transfer function?
- What can cause the coherence function obtained from a system identification experiment to be low?
- Which spectral estimation methods are 1) Unbiased 2) Consistent 3) Have high frequency resolution?
- Why is windowing useful for spectral estimation?
- For which models can the parameters be identified with the standard LS method?
- When does the LS result coincide with the ML estimate?
- What can cause a bias in the LS estimate?
- How do you calculate the covariance matrix for the LS estimate? How do you use the covariance matrix to determine if the estimated parameters are statistically significant?
- What identification methods lend themselves easily to the multiple-input, multiple-output (MIMO) setting?
- How can you estimate the parameters of an arbitrary differentiable model?
- How can you estimate the parameters of an ARMAX model?

- How can you estimate the parameters in a linear model if they change with time?
- Name a few drawbacks with a too slow sampling when performing identification.
- Name a few drawbacks with a too fast sampling when performing identification.
- Explain the difference between bias and variance.
- What does it mean for an estimate to be consistent?
- What properties must the input signal have for a successful identification result?
- When a model has been fit by means of system identification, how do you validate the accuracy of the result?
- What methods are available to choose between two different models of different complexity?
- How do you determine whether a sufficiently complex model has been used or if a more complex model is needed?
- How do the poles of a linear system relate to the system Bode diagram?
- How do the zeros of a linear system relate to the system Bode diagram?
- What insight do the observability and reachability Gramians give?
- What properties does a balanced realization have?
- When the process model is associated with uncertainty, how do you convince yourself about the stability properties of a control loop closed around the identified process?
- How do you obtain a transfer function model of a system after frequency response analysis?
- How do you determine the variance of a prediction made with a linear model obtained through LS estimation?
- For the linear system $Y = \Phi\theta$, what can you tell from the eigenvalues of $\Phi^T\Phi$?
- What is the difference between a spectrogram and a Bode diagram?
- When identifying unstable systems under the influence of closed-loop control, what identification related issues may arise and which methods suffer from these issues?
- How do you prevent aliasing?
- What methods can you employ to identify a continuous time system model?