16.881 – Robust System Design

# Homework #8
# Robust Design Using Simulations / Design of Dynamic Systems

Due Date: Wednesday, 8 July, 1:05, 4-149

Objectives:

- Gain experience with the techniques for inducing noise in simulations introduced in Phadke Ch. 8
- Compare different methods for evaluating noise factor effects on systems.
- Understand the issues in robust design of dynamic systems introduced in Phadke chapter 9.

Assignment

In Chapter 9, Phadke describes the operation of a temperature control circuit and his approach to optimizing its robustness. I have provided a Mathcad sheet that reproduces all the the results from Phadke's chapter 9. This should allow you to experiment with the system and study it and its optimization more deeply.

a) Given the S/N ratio at the optimized control factor settings (that is the settings chosen after one round of robust design, $R_1$=4.0kΩ, $R_2$=5.336kΩ, $R_4$=60.0kΩ, $E_z$=7.2V), what would be the variance in $R_{T\text{-}ON}$ at the three setting of the signal factor $R_3$? Comment on the functional relationship between the variance and the signal factor $R_3$.
b) Set up and run a Monte Carlo simulation to check the results from part (a). Do not use the compound noise strategy, induce noises in all of the noise factors independently. Compare and contrast these results with the results from part (a). Comment on the results.
c) Set up and run the same experiment that Phadke conducts in Chapter 9 but with a different noise strategy. Rather than using compound noise factors, select an appropriate outer array and induce all the noise factors through it. Compare and contrast these results with the results presented in Phadke. Comment on the results.
d) Phadke states that the additive model holds better for $20\log_{10}(\beta)$ than for $\beta$. Provide an anlysis show that this is the case. Support your case with appropriate plots and figures of merit.
e) Phadke states that he was able to improve the robustness of the system still further through iteration. Carry out one additional iteration of robust design on this system and discuss your results.