Where do I go after classical control?

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Classical control theory deals with siso, continuous-time, linear, deterministic, time–invariant, models which are reliable. What's next? Below is a personal list of favorite books, by no means exhaustive.

Multivariable state–space systems. My preferred texts for classroom use are [1] and [2]. The field is stable and these texts make a good choice of relevant material. Several other books are useful as references.

[1] W J Rugh. *Linear System Theory*. Prentice-Hall, Englewood Cliffs, second edition, 1996

[2] J. P. Hespanha. *Linear Systems Theory*. Princeton University Press, Princeton, New Jersey, 2009

Digital controls. All who navigate the gap between academia and applications appreciate [3]. The books by Ogata and by Franklin & Powell also cover the material well.

[3] K.J. Åström and B. Wittenmark. *Computer-Controlled Systems: Theory and Design, Third Edition*. Dover Publications, 2013

Nonlinear systems. I suggest [4] which is a good text for a 1st course. I am not familiar with [5] by the same author but I think it's worth a look. To advance beyond you need to understand some differential geometry, but I think it is very hard to do so using the controls–oriented literature; this would be the beginning of a whole new conversation which we better move offline.

[4] H.K. Khalil. *Nonlinear Systems*. Prentice Hall, 2002

[5] H.K. Khalil. *Nonlinear Control*. Pearson Education, 2014

Stochastic control. To understand the Kalman filter you need to get up to speed in stochastic processes. I have always enjoyed [6]. Afterwards the filter itself is not too hard to follow on any source.

[6] A. Papoulis and S.U. Pillai. *Probability, random variables, and stochastic processes*. McGraw-Hill, 2002

Robust control. If your models are not reliable you need to use robust design tools. Get the concepts from [7], which is an altogether good read, and move on to other references if you feel the need. For the related subject of internal model control, read [8] until it starts becoming less clear; I think it's the only book in this list that's out of print.

[7] J.C. Doyle, B.A. Francis, and A. Tannenbaum. *Feedback control theory*. Macmillan Pub. Co., 1992

[8] M. Morari and E. Zafiriou. *Robust Process Control*. Prentice Hall, 1989

Optimal control is favored by mathematicians but by no means irrelevant for engineers. A must–read if you go into a PhD in controls is [9]. It covers many subjects in multivariable and time–varying systems and gives a good perspective on optimal control, including a deterministic point of view about the Kalman filter.

[9] E.D. Sontag. *Mathematical Control Theory: Deterministic Finite Dimensional Systems*. Springer New York, 2013

The great American novel of adaptive control is yet to be written. Better move this conversation offline as well. Feel free to continue this conversation at any time in the future; my pait@usp.br email may be more reliable.

Dates of publication seem to have become meaningless, so I'm not double checking — by and large these texts are classics.