Correspondenc Course on TAC

The 20 lessons of Technical Applications of Computers with Matlab and FreeMat, at $35 each, are offered by correspondence through email. {You can complete the course by regular mail, and each lesson as the previous ones are completed will be sent to you in PDF.} The foundation for the course content, of course is to reinforce and implement, and even advance beyond the level of the textbook with the 23 sections which you noticed were saved for later.

1. **The Process in CMMI (Sect 5-13) and in Embedded Systems Architecture** (Sect 5-14). You can not get any more systems level than this unless you go all the way to the system of sytems of the 17 vehicles of the Future Combat System.

2. **Some of the NASA reports** mentioned but not discussed from Section 5-15 in the chapter on "The Process".

(1). Stability and Control Derivative and Dynamic Characteristics. {Sounds like the job description for Gulfstream of "Flight Dynamics/S& C".} In our respect for NASA Edwards and the flight test engineering work of the past, we must give due respect to this early {1966} look at efforts to get the S&C derivatives from flight test data in AGARD-AR-549, part 1.

(2). A FORTRAN program for S&C derivatives that derives those derivatives from flight test data, NASA TND-7831, 1975.

NOTE: There is the well-known saying in flight test engineering that "we do not want to re-invent the wheel". While we may not want to, quite often we do and often although frustrating you must appreciate the trend of Naval Aviation, like in Flight Test at Pax River, to stick with the traditional.

(3). A New Method, in 1976, for Test and Analysis of Dynamic S&C, AFFTC-TD-75-4. This publication out of Edwards AFB makes a significant contribution to the history, if not the technical advance, of flight test engineering at Edwards.

(4). Sometimes Systems ID and parameter estimation have been confusing, so that any paper like AGARD-CP-172, paper 16 of May 1975 that clarifies the "Practical Aspects of Using a Maximum Likelihood Estimator" will be welcome.

NOTE: Did you notice some of those computer and data analysis methods required on the Systems Engineering for the B-52 radar replacement such as:

Broad knowledge of detection and estimation techniques (e.g., maximum likelihood, maximum a posteriori [MAP], non-parametric, constant false alarm rate [CFAR], amplitude/frequency/phase). Broad knowledge of classification techniques (e.g., pattern recognition, feature extraction, correlation, demodulation, multiple hypothesis tracking, template techniques, neural networks, support vector machines)

Of course these parametric methods are the most common for radar, but you see how the estimation technique of maximum likehood gets into the systems and data analysis with computer numerical methods.

3. **Cost Function (Sect 6-8)** in Model Methology of Operations Research[1].

4. **"Fminsearch"** (Sect 6-9) of MATLAB, the Nelder and Mead Simplex algorithm.

5. Place of **the cost function, J,** in parametric estimation (Sect 6-10).

6. **MATLAB program for Aircraft Trim plus more.**

7. **(Sect 7-7) Coefficients from Flight Test** versus Mach and Altitude.

8. Working with **the Pendulum System in MATLAB, Sect 7-12**, sometimes the simplest of systems can be the model for much more complex systems. For example some of the parameters in the MIL specs for flight test, were originally derived from simple models like the pendulum. We will us the pendulum in MATLAB to explore the flight test requirments for manuvers like the Dutch roll and Phugoid method.

9. **Files/Directories, the computer handling of data, and interfacing with external programs (Sect 8-3 on drill).** It is very approriate in this Last Chance that our drill with MATLAB also become integrated in Flight Test Engineering. After all, most of us do it for more than fun!

1. Did you notice the mention of the methods of Operations Research in the Systems Engineering job for Boeing? This was previously the more popular title for numerical methods in computers.

10. **The Fourier Transform (Sect 8-4).**

11. **Plotting Polynomials (Sect 8-5)** with the "polyval" of MATLAB with some typical polynomials of flight test engineering.

12. **Matrices of Data and Plotting (Sect 8-6).**

13. **Programming Input and Output in MATLAB (Sect 8-11).**

14. Engineers are not programmers, but must be able to program. Why not use the language of Engineers, that of **MATLAB, for programming.** More programming with (a) looping in MATLAB (Sect 8-13), (b) control flow statements (Sect 8-14), (c) "IF" statements, necessay in all programming languages (Sect 8-15), (d) loops for the programming of missiles (8-16) for we dare not neglect the flight test of missiles, (e) a useful program routine to do the Air Data computer functions,used as a function in MATLAB programming {[Mach,Qbar] = ADC(VT,H)}.

15. A peak in our programming (8-18) with MATLAB skills as we calculate the **state derivatives for the Transport Aircraft.**

NOTE: You see the wisdom of Round 2 in learning of Technical Applications of the Computer with MATLAB. At chapter 8, this task was right there in the flow to be introduced, but if you were still learning MATLAB the skill level was still too high at chapter 8. Besides now, you have more motivation to get a job, or a better job!

16. Optimization in the Excel Data Analysis ToolPak (9-4).

17. Optimization in MINITAB (9-5).

18. Modeling, Parameter Estimation, and System ID (10-7).

19. Statistics Toolbox of MATLAB versus Data Analysis ToolPak (10-8).

20. Back to a simple system again to integrate with the electronics of the LCR circut (Sect 12-2) using the simple model of the spring mass system.

21. Then advance into other electronic circuits which provide a basis for the understanding of the 3 types of controllers for automatic control--PID, PD, and PI. You will remember these controllers of digital control computers as Propor-

tional and Integrating, Proportional and Integrating and Differential, and PD (Sect 12-3).

22. And on to the unique circuits called filters (Sect 12-4), and from circuits into the mathematical and computer methods of LaPlace and the TF (transfer function).

23. Drill with the very important tool of the Transfer Function on well known circuits of electronics technology (12-6).

NOTE: Did you see model-based design in the job description for Flight Dynamics at Gulfstream. Of course, while they mean the more modern methologies of like modeling in Simulink, models are helpful at all levels. You might consider that they are analogies and ways to visualize a circuit or system. You might also recall that for every physical system there is an analogous electronic model, and vice versa.

Examples of How Chapter Subjects from which Sections Taken to form the outline for the course

1. From chapter 5, "The Process", three sections are taken--13 and 14.
2. Since the additions NASA reports mentioned in 5-13 are really sort of a "History of Some data analylsis technics and methods", it therefore will be a separate lesson in the correspondence course.

NOTE: this is not necessarily the sequence of the Course Outline.

3. More studies and applications on 6-8 and 6-9 must be part of more advance on "Aircraft Trim". This would include programming work in Matlab and/or FreeMat, more advanced than in the text. Yes, the subject matter was introduced in Chapter 6 on "Data Parameter and Analysis" as one example of application.

NOTE: The course like the book is heavy on applications, and you must have access to FeeMat or Malab before you enroll. FreeMat is available free online to all with a simple download.