

BLM2041 Signals and Systems

Syllabus

The Instructors:

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Course Details

- Course Code : BLM 2041
- Course Name:
Signals and Systems for Computer Engineers
(Bilgisayar Mühendisleri için Sinyaller ve Sistemler)

Instructor :

1- Dr. Öğr. Üyesi Ali Can Karaca

2- Öğr. Gör. Dr. Ahmet Elbir

Assesment

Method	Quantity	(%)
Quiz	-	00
Homework	3-4	25
Midterm Exam(s)	1	35
Final Exam	1	40
Attendance & participation	-	00

By University Rule:

Your average < 40 \rightarrow FF

Course Outline

1. Introduction.

Mathematical Representation of Signals. Mathematical Representation of Systems.

2. Sinusoids.

Review of Sine and Cosine Functions. Sinusoidal Signals. Sampling and Plotting Sinusoids. Complex Exponentials and Phasors. Phasor Addition. Time Signals.

3. Spectrum Representation.

The Spectrum of a Sum of Sinusoids. Beat Notes. Periodic Waveforms. Fourier Series Analysis and Synthesis. Time-Frequency Spectrum. Frequency Modulation.

4. Sampling and Aliasing.

Sampling. Spectrum View of Sampling and Reconstruction. Discrete-to-Continuous Conversion. The Sampling Theorem.

5. Continuous-Time LTI Systems and the Convolution Integral.

Establishing a General Input-Output Relationship. Working with the Convolution Integral.

6. Discrete-Time LTI Systems and the Convolution Sum.

Specializing the Input/Output Relationship. Working with the convolution Sum.

7. LTI System Differential and Difference Equations in the Time Domain.

Obtaining the differential/difference equations for the input-output relations of systems. Solution of differential and discrete equations in the time domain.

Course Outline

8. The Fourier Transform for Continuous-Time Signals and Systems.

Continuous-Time Aperiodic Signals. Continuous-Time Fourier Transform. Properties of Continuous-Time Fourier Transform.

9. The Discrete Time Fourier Transform for Discrete-Time Signals.

Discrete-Time Aperiodic Signals. Discrete-Time Fourier Transform. Properties of Discrete-Time Fourier Transform

10. The Laplace Transform for Continuous Time.

Laplace Transform. Common Laplace Transforms. Properties Of the Laplace Transform. Inverse Laplace Transform. Poles and Zeros in the s-plane.

11. The Z Transform for Discrete Time.

Z Transform. Common Z Transforms. Properties Of the Z Transform. Inverse Z Transform. Poles and Zeros in the z-plane.

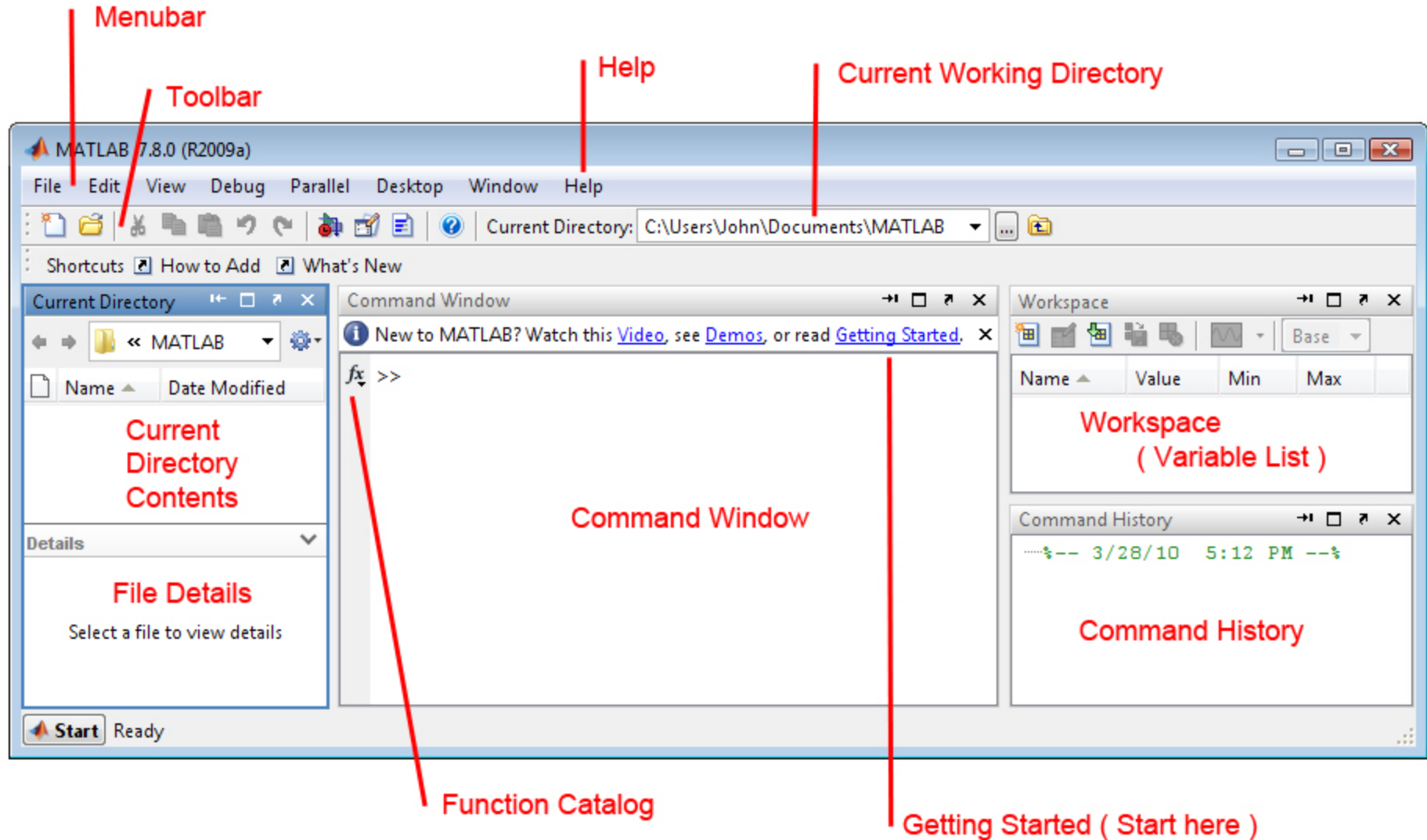
COURSE OBJECTIVES

- Students will be able to:
- Understand **mathematical** descriptions of Signals and Systems
- Express those descriptions as computer **implementations** (MATLAB, OCTAVE, SCILAB, R, PYTHON)
 - Yıldız Technical University provides MATLAB License.
 - OCTAVE, SCILAB, R and PYTHON are free

COURSE OBJECTIVES

- MATLAB
 - <https://www.mathworks.com/>
- SCILAB
 - <https://www.scilab.org/>
- OCTAVE
 - <https://www.gnu.org/software/octave/>
- R
 - <https://www.r-project.org/>
- PYTHON
 - <https://www.python.org/>

MATLAB environment



SCILAB environmet

The screenshot displays the SCILAB environment interface, which includes a file navigator, a central console, and a variable navigator.

File Navigator (left): Shows the file system structure with folders like Applications, Library, Network, System, Users, Volumes, bin, cores, dev, etc, home, net, private, sbin, tmp, usr, var, and mach_kernel.

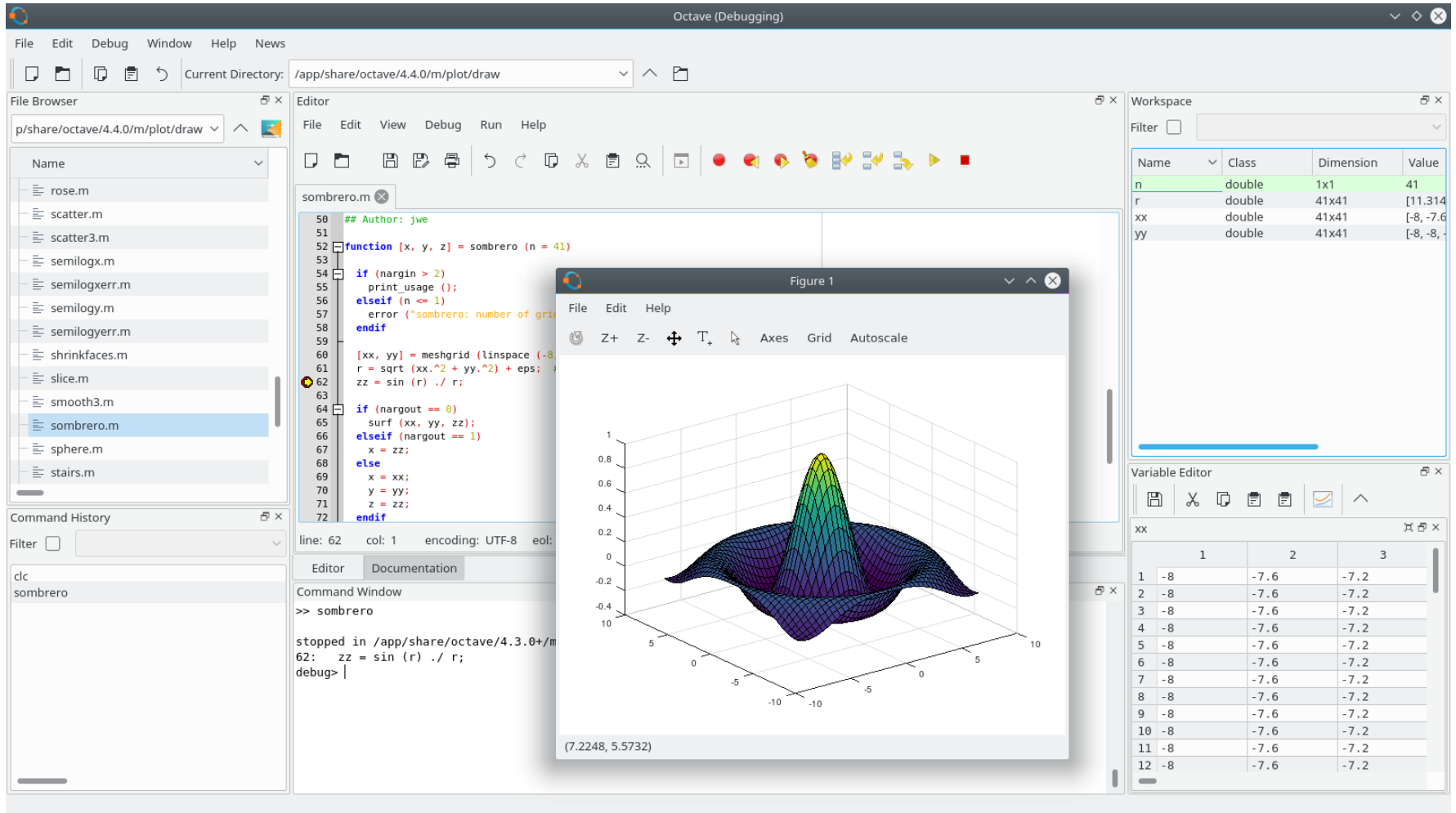
Console (center): Displays the initialization process and the execution of the command `a=rand(10,10)`. The output shows a 10x10 matrix of random numbers, split into two sections: "column 1 to 5" and "column 6 to 10".

Variable Navigator (right): Lists the variables created in the session, including their names, dimensions, types, and visibility. The variables listed are:

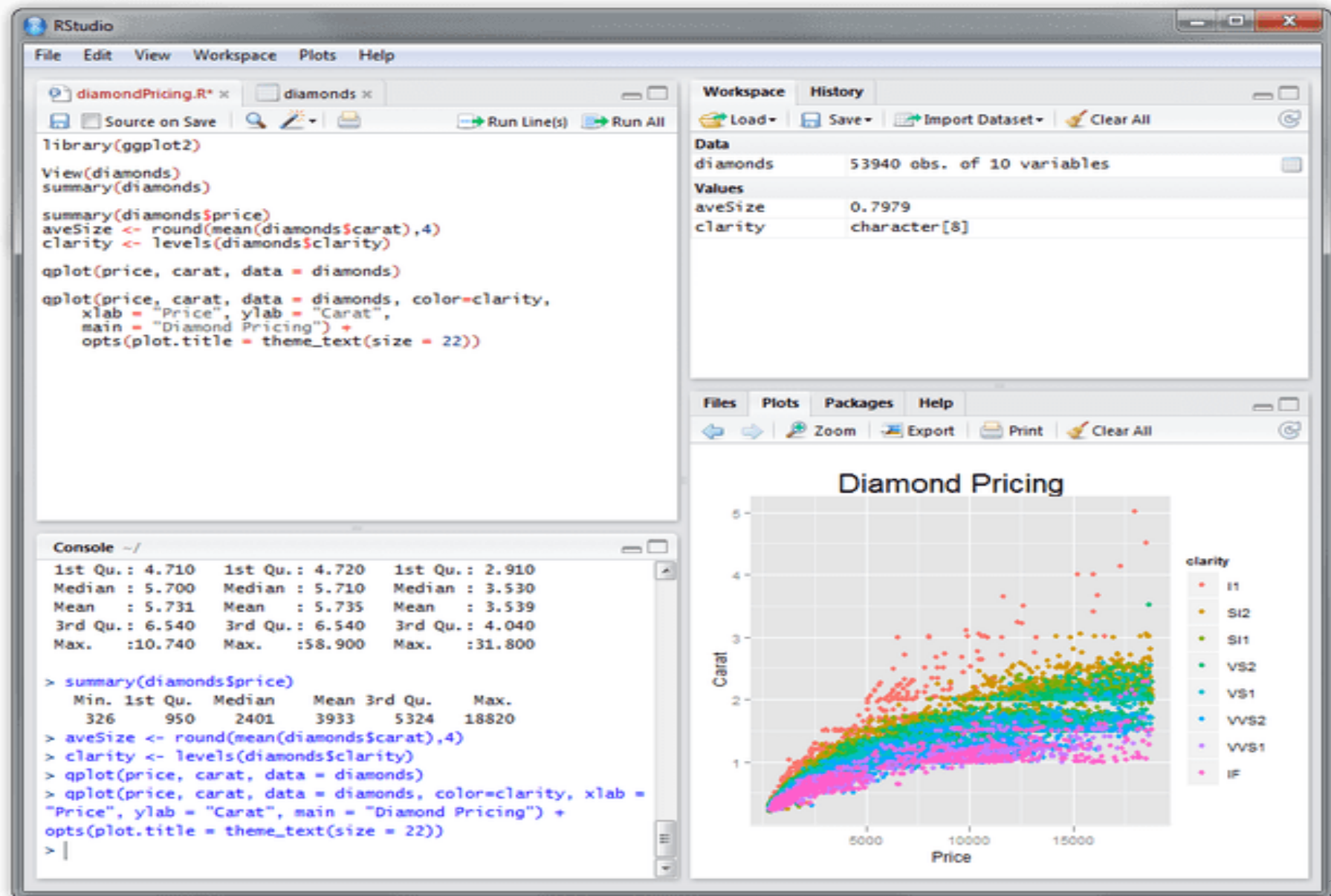
Nom	Dimension	Type	Visibilité
a	10x10	Double local	
home	1x1	Chaine de... local	
PWD	1x1	Chaine de... local	
%tk	1x1	Boolean local	
%f	1x1	Boolean local	
%T	1x1	Boolean local	
%nan	1x1	Double local	
%inf	1x1	Double local	
SCI	1x1	Chaine de... local	
SCIDIR	1x1	Chaine de... local	
TMPPDIR	1x1	Chaine de... local	
%gui	1x1	Boolean local	
%ffw	1x1	Boolean local	
%t	1x1	Boolean local	
%f	1x1	Boolean local	
%eps	1x1	Double local	
%io	1x2	Double local	
%i	1x1	Double local	
%e	1x1	Double local	
%pi	1x1	Double local	
%modaWa...	1x1	Boolean global	
%toolboxe...	1x1	Double global	
%toolboxe...	1x1	Chaine de... global	

Command History (bottom right): Shows the commands entered in the console, including the command `a=rand(10,10)`.

OCTAVE environment



Rstudio (IDE for R)



Spyder (IDE for PYTHON)

The screenshot displays the Spyder Python IDE interface. The main window is titled "Spyder (Python 3.6)". The menu bar includes File, Edit, Search, Source, Run, Debug, Consoles, Projects, Tools, View, and Help. The toolbar contains icons for file operations, running, and debugging. The Editor pane shows a file named `tmm_core.py` with the following code:

```
385 T = (s_data['T'] + p_data['T']) / 2.
386 return {'R': R, 'T': T}
387
388 def position_resolved(layer, distance, coh_tmm_data):
389     """
390     Starting with output of coh_tmm(), calculate the Poynting vector,
391     absorbed energy density, and E-field at a specific location. The
392     location is defined by (layer, distance), defined the same way as in
393     find_in_structure_with_inf(...).
394
395     Returns a dictionary containing:
396
397     * poyn - the component of Poynting vector normal to the interfaces
398     * absor - the absorbed energy density at that point
399     * Ex and Ey and Ez - the electric field amplitudes, where
400       z is normal to the interfaces and the light rays are in the x,z plane.
401
402     The E-field is in units where the incoming |E|=1; see
403     https://arxiv.org/pdf/1603.02720.pdf for formulas.
404     """
405     if layer > 0:
406         v,w = coh_tmm_data['vw_list'][layer]
407     else:
408         v = 1
409         w = coh_tmm_data['r']
410     kz = coh_tmm_data['kz_list'][layer]
411     th = coh_tmm_data['th_list'][layer]
412     n = coh_tmm_data['n_list'][layer]
413     n_0 = coh_tmm_data['n_list'][0]
414     th_0 = coh_tmm_data['th_0']
415     pol = coh_tmm_data['pol']
416
417     assert ((layer >= 1 and 0 <= distance <= coh_tmm_data['d_list'][layer])
418            or (layer == 0 and distance <= 0))
419
420     # Amplitude of forward-moving wave is Ef, backwards is Eb
421     Ef = v * exp(1j * kz * distance)
422     Fb = w * exp(-1j * kz * distance)
```

The Help pane on the right shows the documentation for the `coh_tmm` function:

coh_tmm

Definition: `coh_tmm(pol, n_list, d_list, th_0, lam_vac)`

Type: Function of `tmm.tmm_core` module

Main "coherent transfer matrix method" calc. Given parameters of a stack, calculates everything you could ever want to know about how light propagates in it. (If performance is an issue, you can delete some of the calculations without affecting the rest.)

`pol` is light polarization, "s" or "p".

`n_list` is the list of refractive indices, in the order that the light would pass through them. The 0'th element of the list should be the semi-infinite medium from which the light enters, the last element should be the semi-infinite medium to which the light exits (if any exits).

`th_0` is the angle of incidence: 0 for normal, $\pi/2$ for glancing. Remember, for a dissipative medium, $\text{angle}(\text{coh_tmm}(\text{'s'}, \text{n_list}, \text{d_list}, \text{th_0}))$ should be $\pi/2$.

The IPython console at the bottom shows the following interactions:

```
In [10]: import tmm
In [11]: temp = tmm.coh_tmm('s', [1, 1.7, 2.1], [inf, 250, inf], 0, 500)
In [12]: (temp['R'], temp['T'])
Out[12]: (0.062435840423349355, 0.93756415957665051)
In [13]: cmath.phase(temp['r'])
Out[13]: 2.751964575481417
In [14]: cmath.phase(temp['r']) / degree
Out[14]: 157.67595554459646
In [15]:
```

The status bar at the bottom indicates: Permissions: RW, End-of-lines: CRLF, Encoding: UTF-8, Line: 405, Column: 11, Memory: 47 %.

Course Objectives (In details)

Academic knowledge

- Students will be able to:
 - Understand and develop simple mathematical models for representing signals and systems
 - Understand the relationship between time and frequency domain models of dynamic systems
 - Convert time to frequency-domain models and vice versa
 - Understand the relationship between continuous and discrete-time models

Intellectual skills

- Students will be able to:
 - Build a mathematical model from a real-life problem related to signals and systems
 - Interpret results achieved by mathematical solutions

Practical skills

- Students will be able to:
 - Express models and methods as computer implementations (MATLAB or OCTAVE)
 - Yıldız Technical University provides MATLAB License.
 - Apply Matlab/Octave for analysis and simulation of continuous and discrete time systems
 - Analyse mathematical solutions in the context of the original problem

Transferable skills

- Students will be able to:
 - Choose appropriate approach in problem solving situation
 - Present and communicate formalised results and conclusions

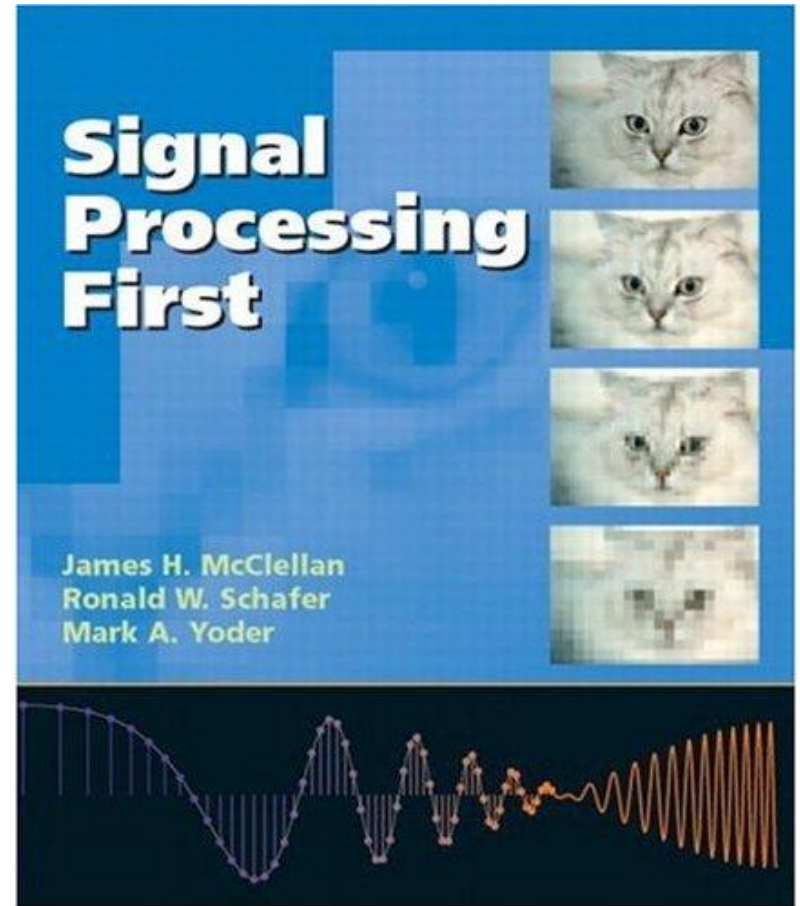
Main course book

Signal Processing First

by James H McClellan,
Ronald W. Schaffer
and Mark A. Yoder.

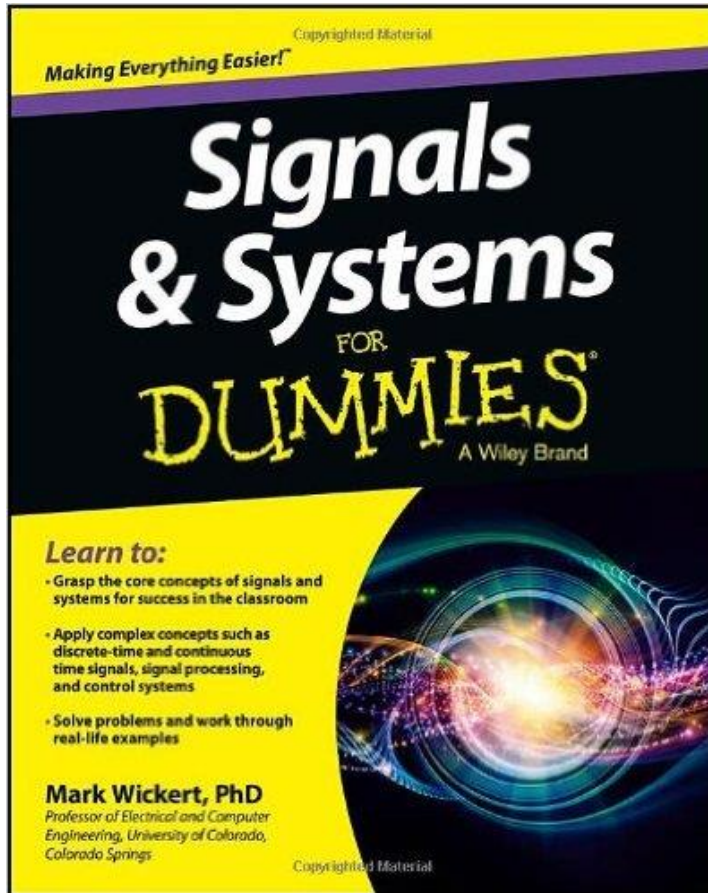
Published by Prentice
Hall.

Isbn: 0-13-120265-0



Some Other Books

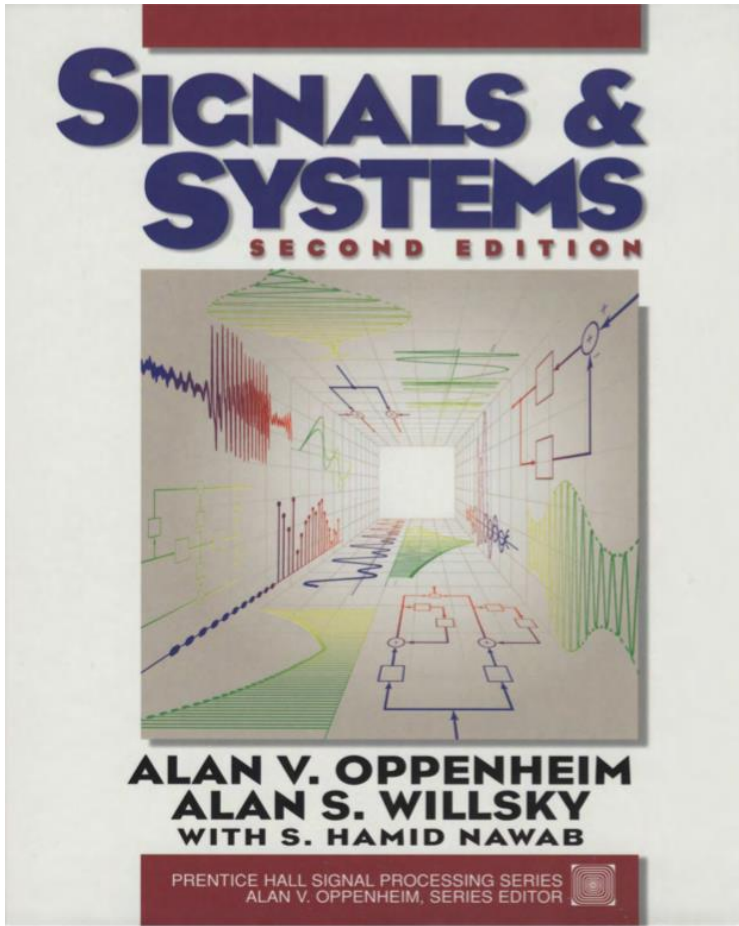
- by Mark Wickert



Wickert, Mark. *Signals and Systems for Dummies*. John Wiley & Sons, 2013.

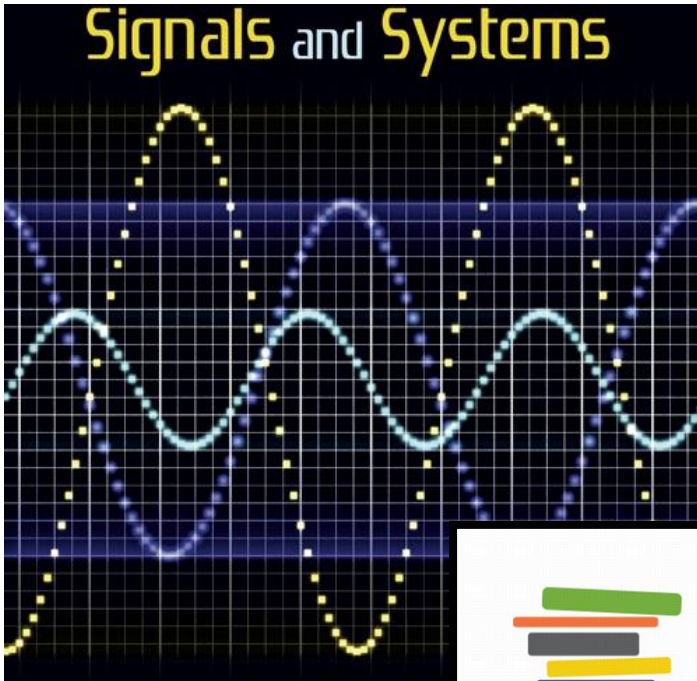
Some Other Books

- by [Alan. V. Oppenheim](#) and [Alan S. Willsky](#)



Oppenheim, Alan V., Alan S. Willsky, and Syed Hamid Nawab. "Signals and systems 2nd ed." *New Jersey: Prentice Hall*(1997).

Some Other Books



- Online e-book by [Richard Baraniuk](#)



<https://cnx.org/contents/d2CEAGW5>

Rules of the Conduct

- No eating /drinking in class
 - *except water*
- Cell phones must be kept outside of class or switched-off during class
 - *If your cell-phone rings during class or you use it in any way, you will be asked to leave and counted as unexcused absent.*
- No web surfing and/or unrelated use of computers,
 - *when computers are used in class or lab.*

Rules of the Conduct

- You are responsible for checking the class web page often for announcements.
- Academic dishonesty and cheating will not be tolerated and will be dealt with according to university rules and regulations
 - *Presenting any work, or a portion thereof, that does not belong to you is considered academic dishonesty.*
- University rules and regulations:
 - <http://www.ogi.yildiz.edu.tr/category.php?id=17>
 - https://www.yok.gov.tr/content/view/544/230/lang,tr_TR/

Attendance Policy

- The requirement for attendance is **70%**.
 - *Hospital reports are not accepted to fulfill the requirement for attendance.*
 - *The students, who fail to fulfill the attendance requirement, will be excluded from the final exams and the grade of **F0** will be given.*
 - **Absent more than 12 hours → F0**

Seeing the Big Picture

Getting Started
with Signals and
Systems

Exploring the
Time Domain

Picking Up the
Frequency
Domain

Entering the s -
and z -Domains

