

## COURSE DESCRIPTION

Course Name: DSP For Wireless Communications  
Course Start Date: May 19, 2022, videos released weekly  
Q&A Workshops: Thursdays: May 26, June 9, 16, 23 6-7:30pm EST  
Location: Zoom Webinar  
Speaker: Dan Boschen

### Pre-Recorded Videos combined with Live Q&A Workshops

This is a hands-on course providing pre-recorded lectures that students can watch on their own schedule and an unlimited number of times prior to live Q&A/Workshop sessions with the instructor. Ten 1.5 hour videos released 2 per week while the course is in session will be available for up to two months after the conclusion of the course. If a sufficient number of students sign-up, a second workshop session may be added earlier in the day for convenience to those in other time-zones. Workshop sessions are recorded and Dan is available via e-mail throughout the course to answer questions as well.

### Course Summary

This course is a fresh view of the fundamental and practical concepts of digital signal processing applicable to the design of mixed signal design with A/D conversion, digital filters, operations with the FFT, and multi-rate signal processing. This course will build an intuitive understanding of the underlying mathematics through the use of graphics, visual demonstrations, and applications in GPS and mixed signal (analog/digital) modern transceivers. This course is applicable to DSP algorithm development with a focus on meeting practical hardware development challenges in both the analog and digital domains, and not a tutorial on working with specific DSP processor hardware.

The screenshot shows a Jupyter Notebook interface. The top section is titled "2 The FFT Intuitively Explained" and contains the equation  $DFT = DFT_{\text{even}} + W_N^k DFT_{\text{odd}}$ . Below this is a block diagram showing a signal being split into even and odd components, each multiplied by a twiddle factor  $W_N^k$ , and then summed. A smaller diagram below shows the addition and subtraction of two signals to produce a single signal. The bottom section is titled "3 Practical Approaches for Interpolation with Polyphase Filters" and shows a block diagram of a polyphase filter structure with multiple FIR filters (FIR 1, FIR 2, FIR 3, ..., FIR I) operating at Rate R, which are then summed and filtered to produce an output at Rate R I. Below the diagrams is a code cell with the following Python code:

```
In [ ]: # signal
signal = x[1:N, N:N]
k = sp.linspace(0, 12)
out = fft(X*signal)
plt.figure()
plt.plot(w, 20*np.log10(X*sig))
```

The bottom section also includes a code cell with the following text:

```
In [ ]: # give a input signal rate fs with desired interpolation by R
R = 20
# consider the following characteristics
```

### Jupyter Notebooks:

This long-running course now includes Jupyter Notebooks which incorporates graphics together with Python simulation code to provide a "take-it-with-you" interactive user experience. No knowledge of Python is required but the notebooks will provide a basic framework for proceeding with further signal processing development using that tools for those that have interest in doing so.

This course will not be teaching Python, but using it for demonstration. A more detailed course on Python itself is covered in a separate course also taught by Dan titled "Python Applications for Digital Design and Signal Processing".

Students will be encouraged but not required to load all the Python tools needed, and all set-up information for installation will be provided prior to the start of class.

## Target Audience:

All engineers involved in or interested in signal processing applications. Engineers with significant experience with DSP will also appreciate this opportunity for an in-depth review of the fundamental DSP concepts from a different perspective than that given in a traditional introductory DSP course. Please contact Dan at [boschen@loglin.com](mailto:boschen@loglin.com) if you are uncertain about your background or if you would like more information on the course.

## Benefits of Attending/ Goals of Course:

Attendees will build a stronger intuitive understanding of the fundamental signal processing concepts involved with digital filtering and mixed signal analog and digital design. With this, attendees will be able to implement more creative and efficient signal processing architectures in both the analog and digital domains. The knowledge gained from this course will have immediate practical value for any work in the signal processing field.

## Topics / Schedule:

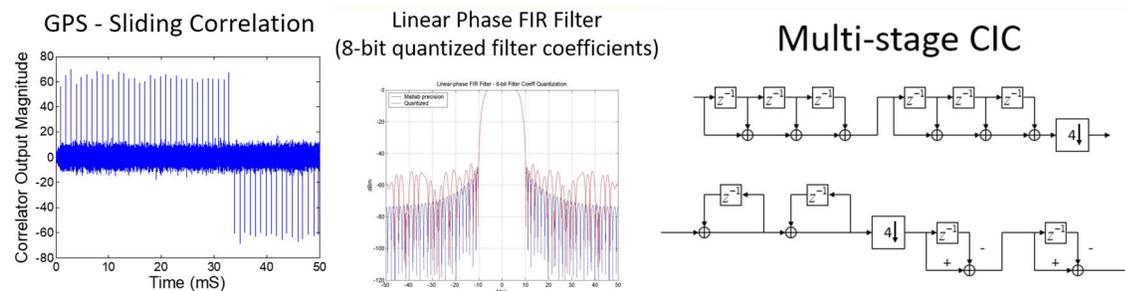
Class 1: Correlation, Fourier Transform, Laplace Transform

Class 2: Sampling and A/D Conversion, Z –transform, D/A Conversion

Class 3: IIR and FIR Digital filters, Direct Fourier Transform

Class 4: Windowing, Digital Filter Design, Fixed Point vs Floating Point

Class 5: Fast Fourier Transform, Multi-rate Signal Processing, Multi-rate Filters



## Speaker's Bio:

Dan Boschen has a MS in Communications and Signal Processing from Northeastern University, with over 25 years of experience in system and hardware design for radio transceivers and modems. He has held various positions at Signal Technologies, MITRE, Airvana and Hittite Microwave designing and developing transceiver hardware from baseband to antenna for wireless communications systems and has taught courses on DSP for over 15 years. Dan is a contributor to [dsprelated.com](http://dsprelated.com) and Signal Processing Stack Exchange [dsp.stackexchange.com/](http://dsp.stackexchange.com/), and is currently at Microchip (formerly Microsemi and Symmetricom) leading design efforts for advanced frequency and time solutions.

For more background information, please view Dan's Linked-In page at: <http://www.linkedin.com/in/danboschen>