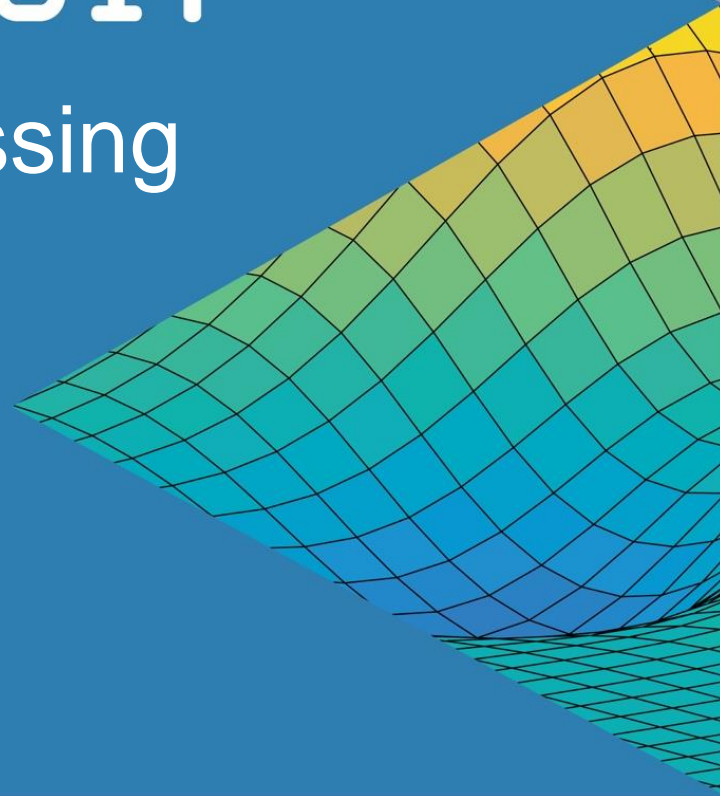


MATLAB EXPO 2017

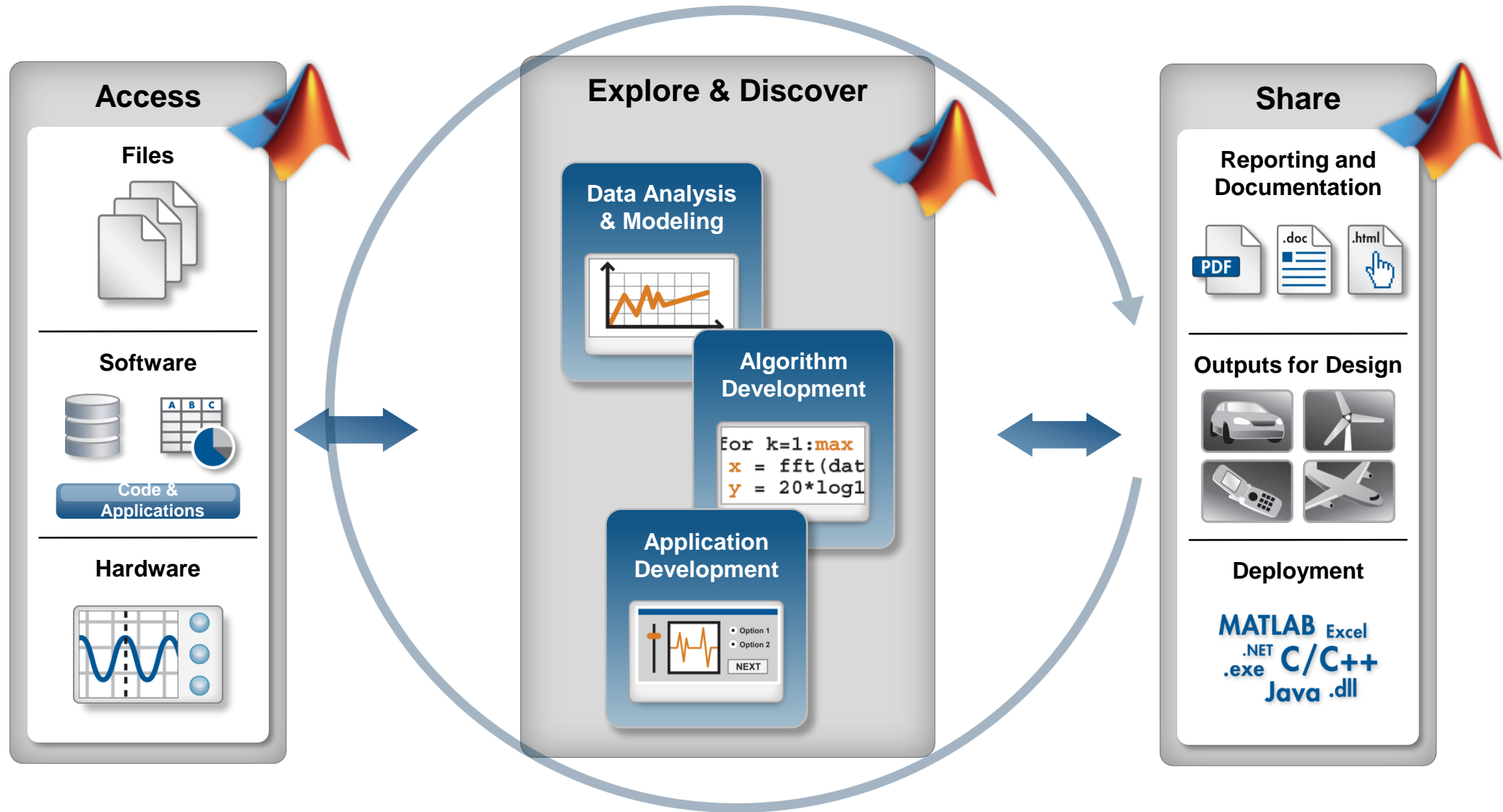
Introduction to Signal Processing

Modifying, measuring and extracting
features from signals

Steven Thomsett



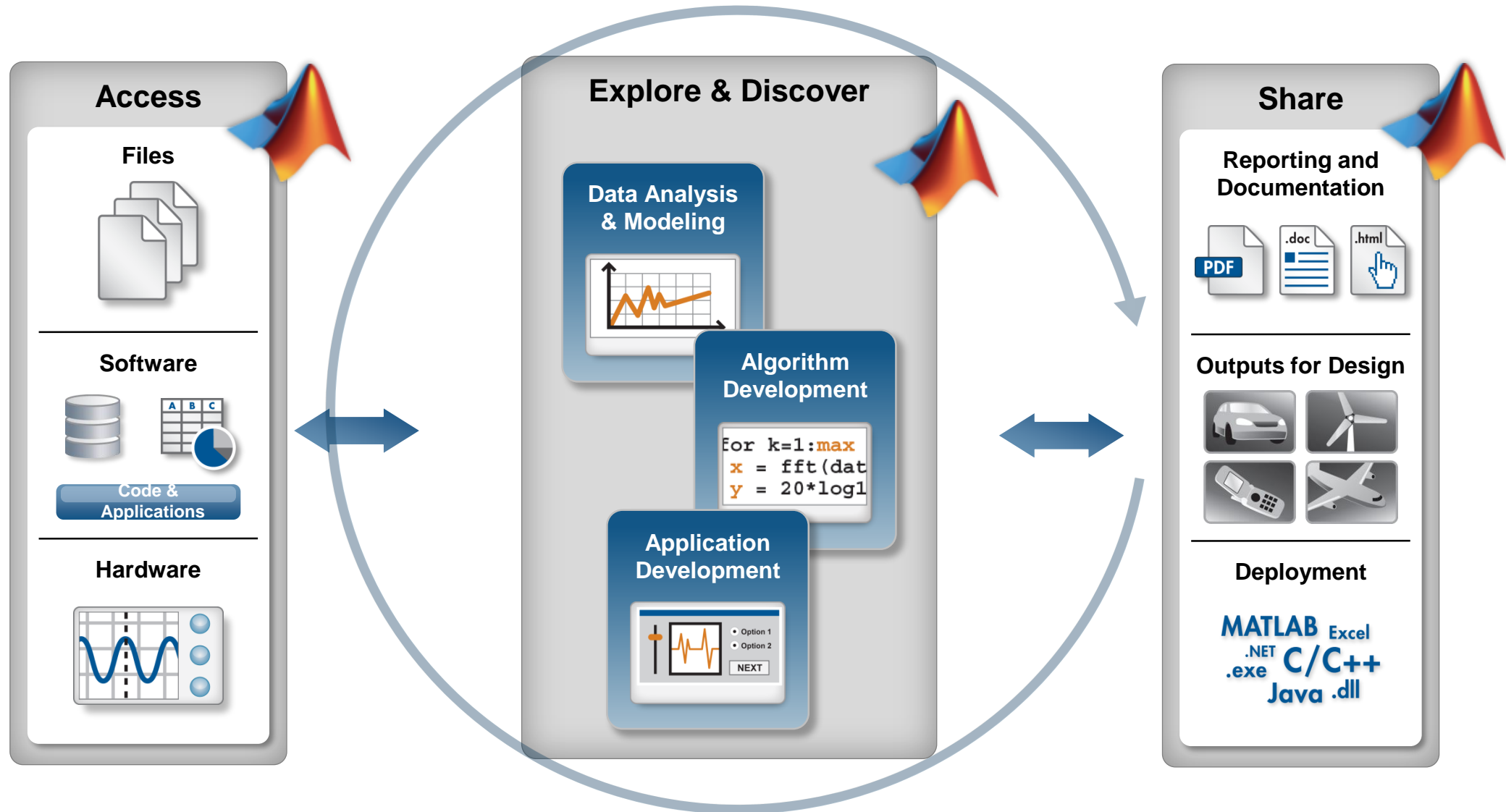
Technical Computing Workflow



Key Takeaways

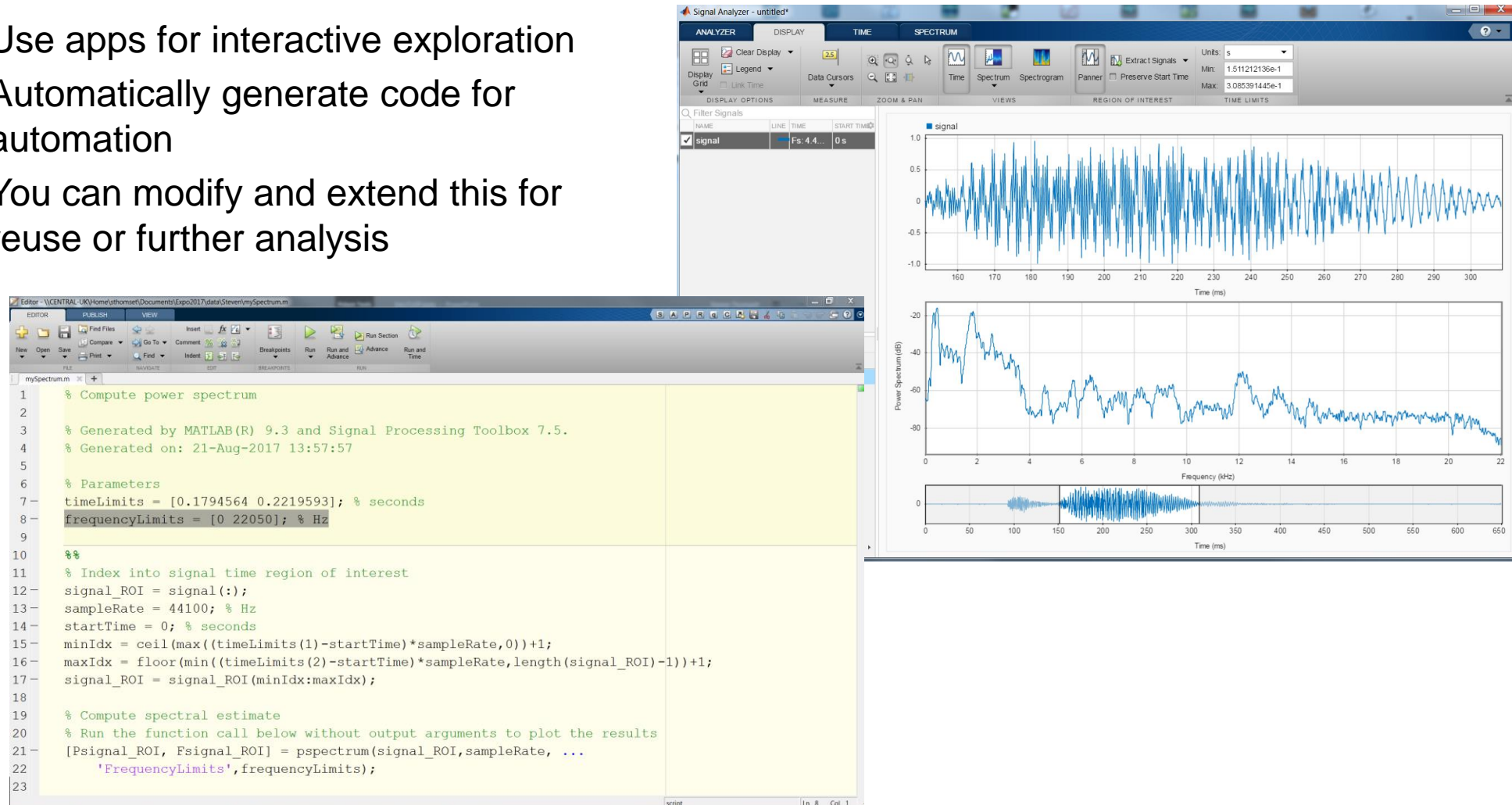
- Many signal processing techniques are common across workflows and applications
- MATLAB accelerates algorithm exploration with apps and common functions
- MATLAB provides the framework to transition from exploration to implementation

Technical Computing Workflow

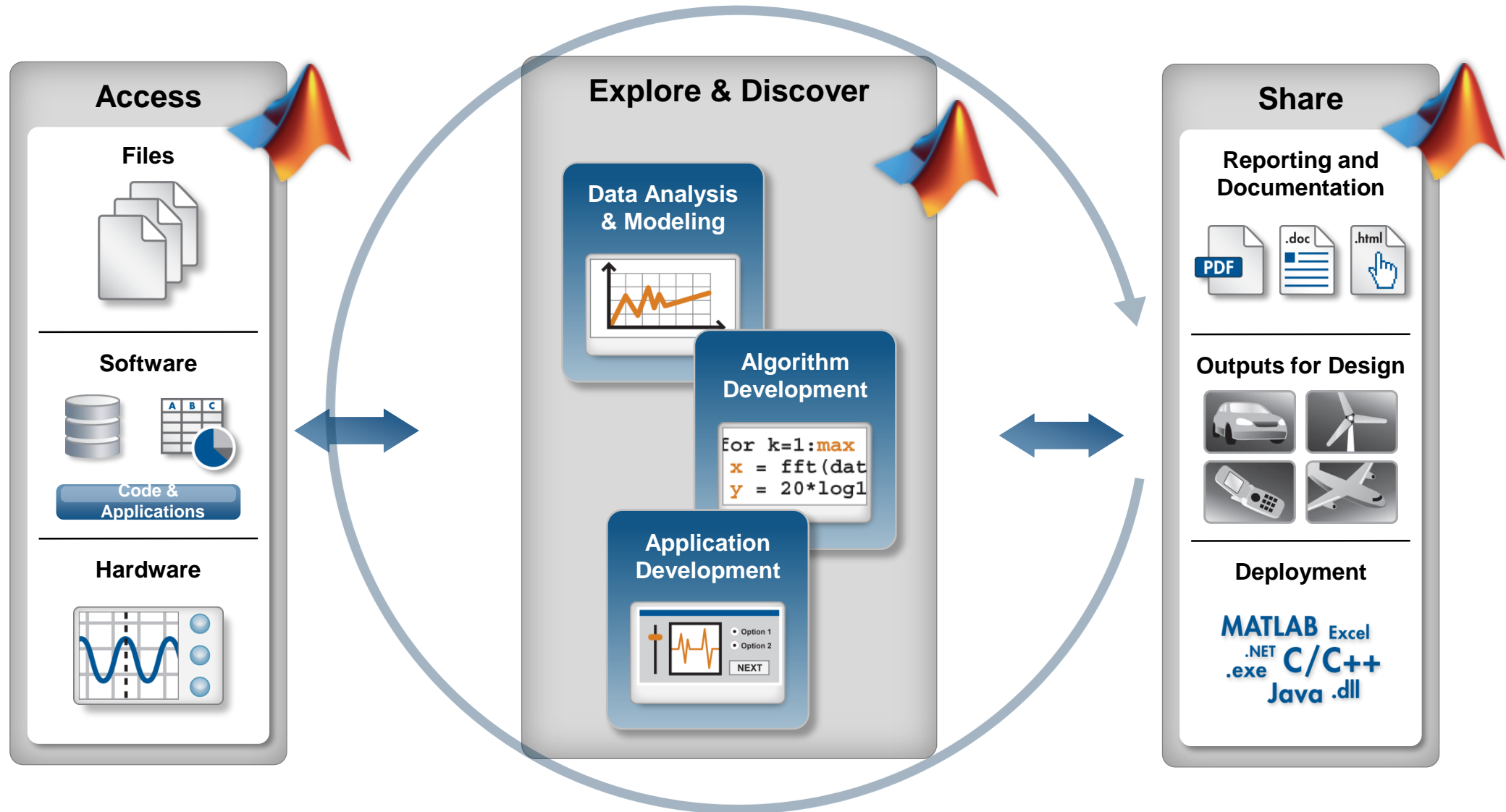


Exploring a signal interactively

- Use apps for interactive exploration
- Automatically generate code for automation
- You can modify and extend this for reuse or further analysis



Technical Computing Workflow



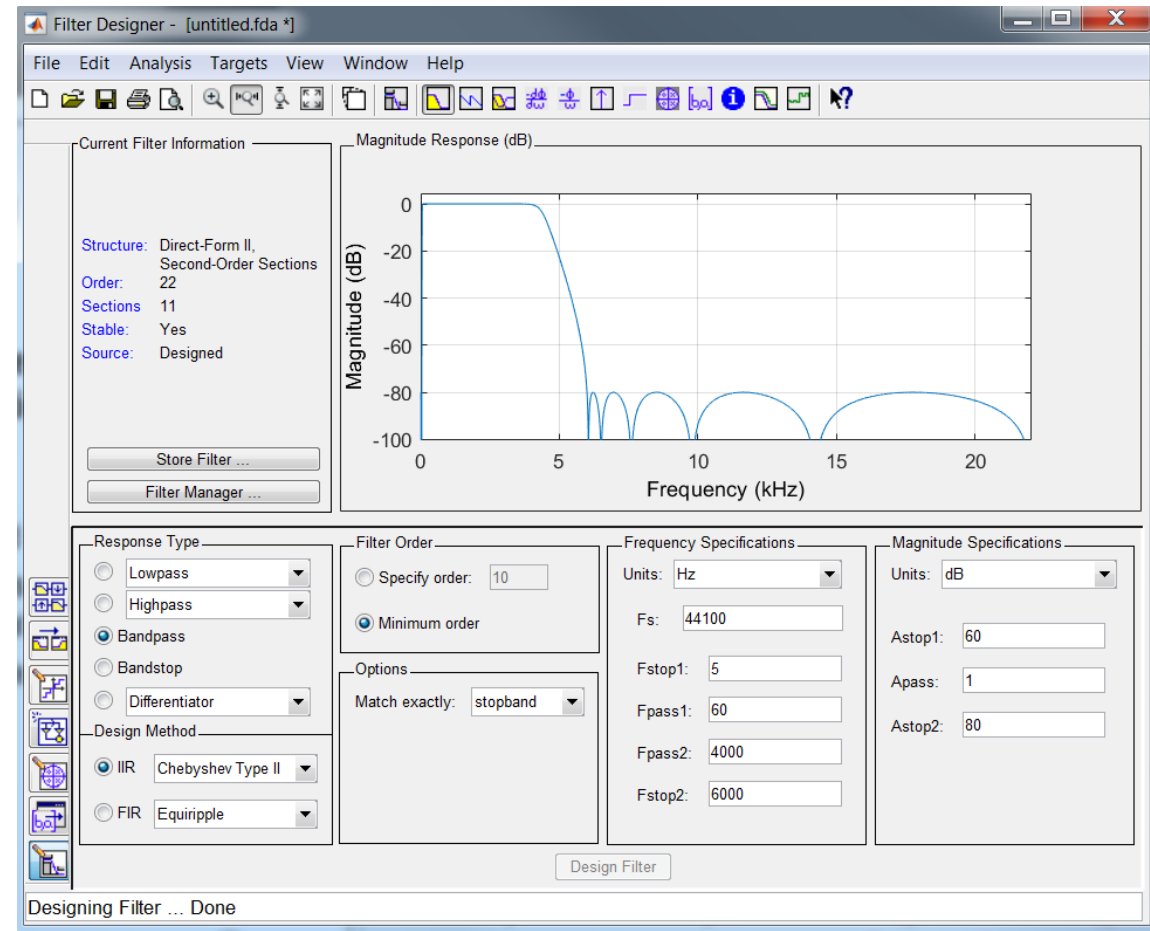
Design filters based on specifications

Interactively design filters based on specifications

- Can try settings and see the response immediately
- Generate MATLAB function when you are happy

Filter signal

```
bpFilter = filterDesignerCode;
signal_ROI = filter(bpFilter, signal_ROI);
```



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LIVE EDITOR INSERT FIGURE VIEW

FILE NAVIGATE TEXT CODE SECTION RUN

mySpectrumPlot.mlx

Index into signal time region of interest

This code was automatically generated by the Signal Analyzer app.

```

signal_ROI = signal(:);
sampleRate = 44100; % Hz
startTime = 0; % seconds
minIdx = ceil(max((timeLimits(1)-startTime)*sampleRate,0))+1;
maxIdx = floor(min((timeLimits(2)-startTime)*sampleRate,length(signal_ROI)-1))+1;
signal_ROI = signal_ROI(minIdx:maxIdx);

```

Filter signal

Call the function generated by the Filter Designer app to create a filter and then use it.

```

bpFilter = filtDesignerCode;
signal_ROI = filter(bpFilter,signal_ROI);

```

Compute spectral estimate

This code was automatically generated from the Signal Analyzer app.

```

Leakage = 1;
[Psignal_ROI, Fsignal_ROI] = pspectrum(signal_ROI,sampleRate, ...
    'FrequencyLimits',frequencyLimits,'Leakage',Leakage);

```

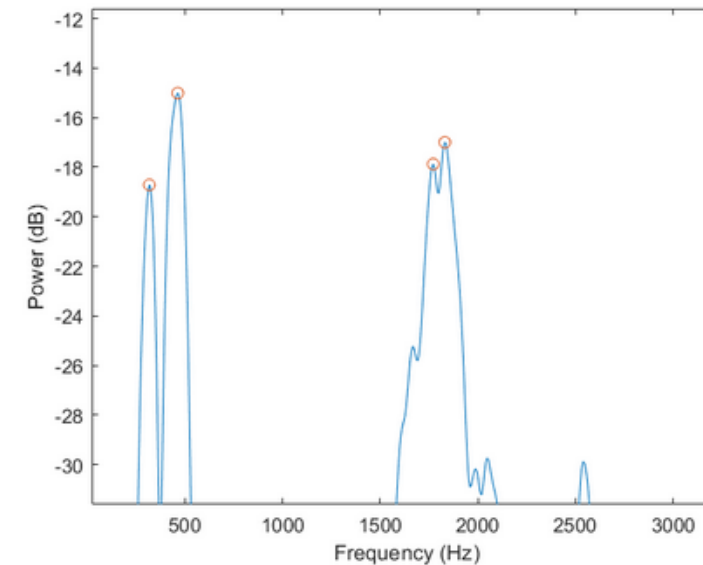

Extracting features and metrics from signals

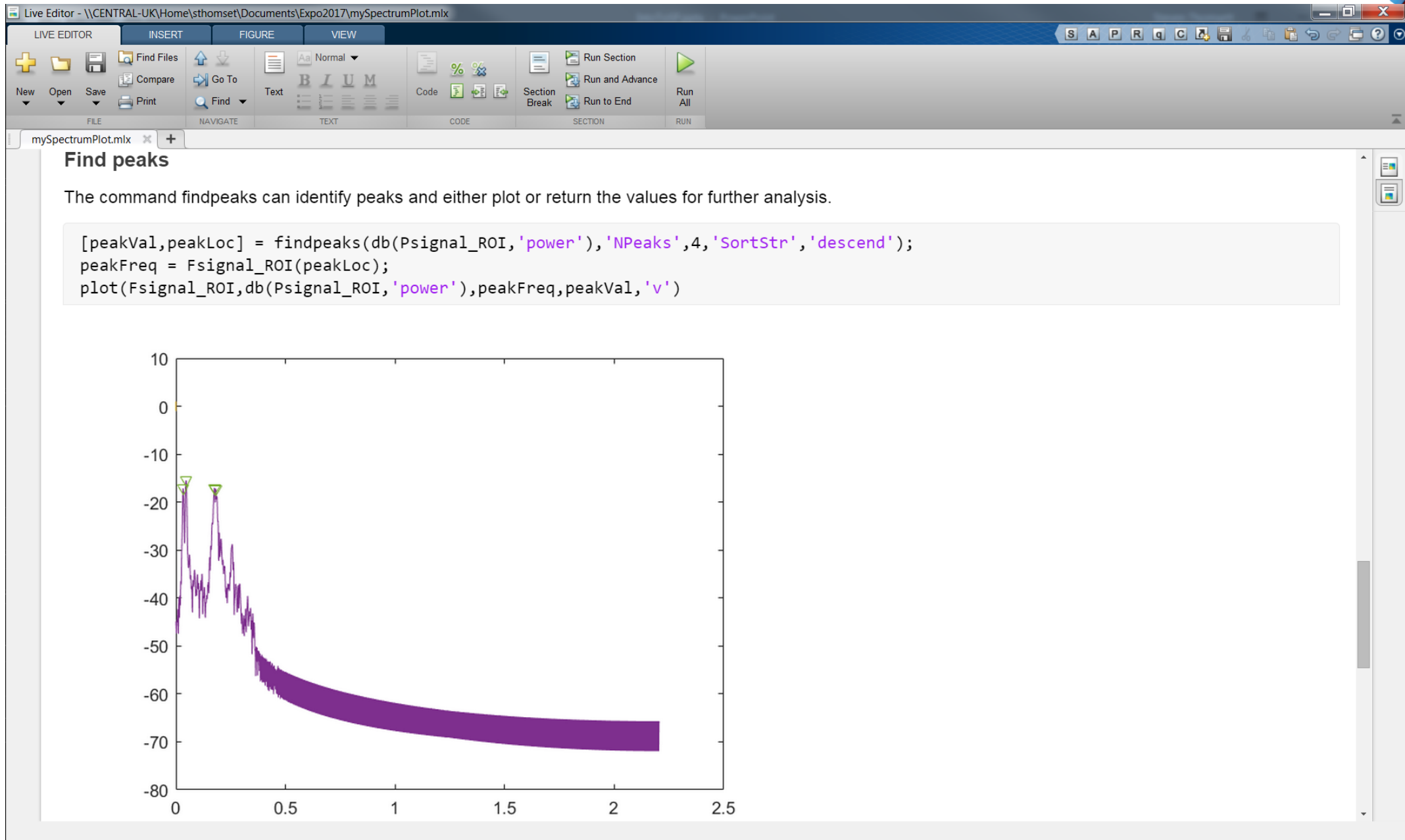
Use common measurement techniques to accelerate development

- Detect features such as peaks and change points
- Extract metrics based on statistics or spectrum

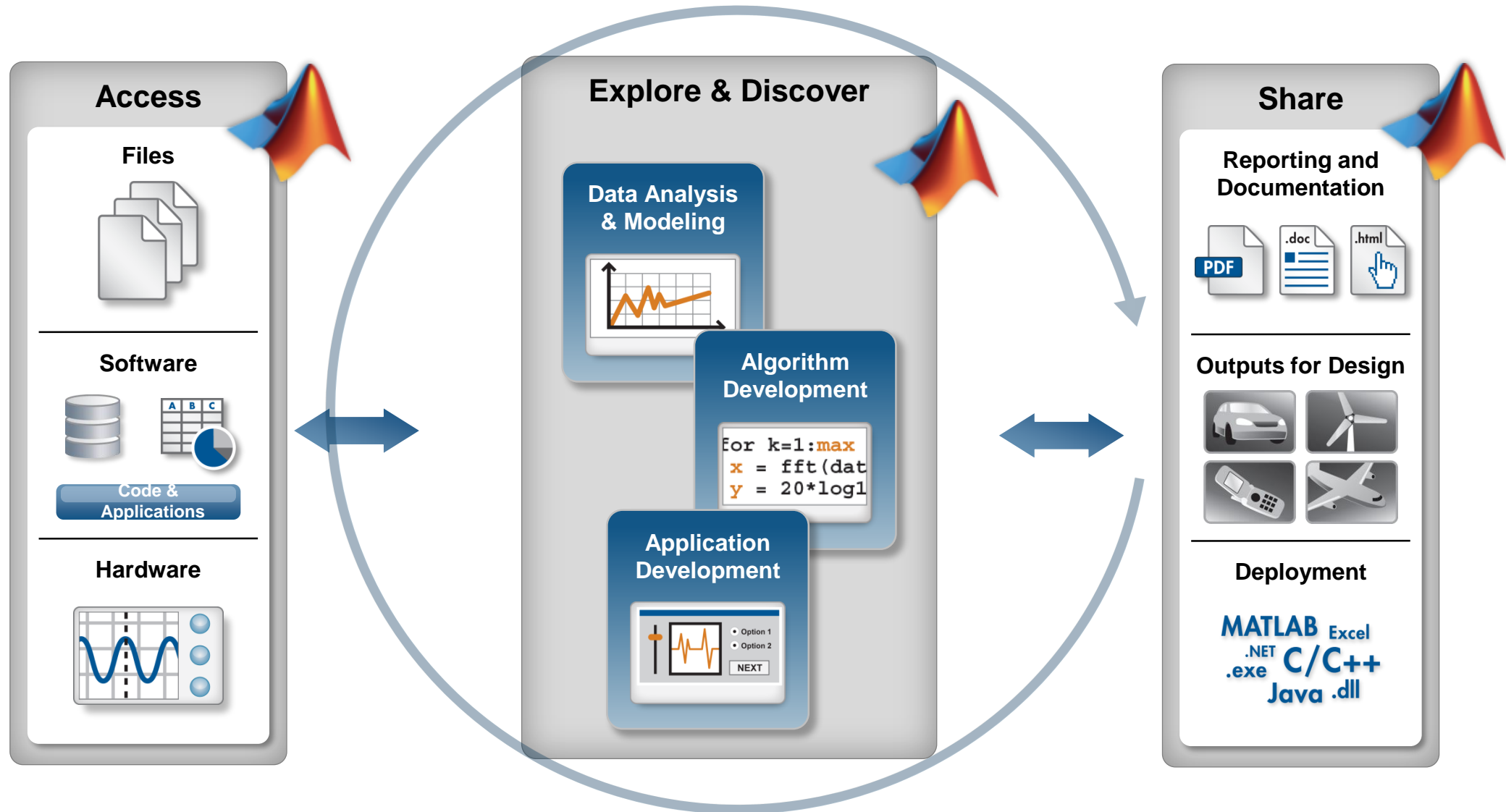
Find peaks

```
[peakVal, peakLoc] = findpeaks(Psignal_ROI, 'NPeaks', 4, 'SortStr', 'descend');  
hold on  
plot(Fsignal_ROI(peakLoc), db(peakVal, 'power'), 'o')  
  
xlim([23 3246])  
ylim([-31.6 -11.6])
```





Technical Computing Workflow



Considerations for transitioning to implementation

- Reusing components
 - Configuring parameters
 - Streaming data over time
 - Automated triggers
 - Integrating components
- Find out more about approaches to system modelling
 - Reusing and Prototyping Code to Accelerate Innovation: Smart Voice Interfaces 14:30
 - Introduction to Simulink and Stateflow 14:00



Gabriele Bunkheila,
MathWorks



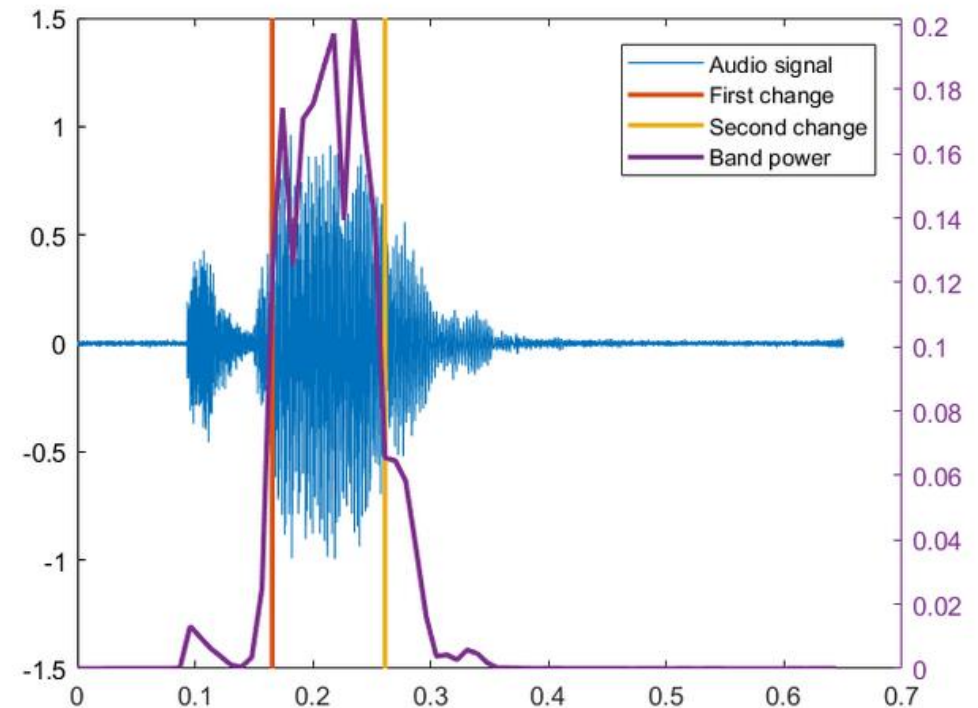
Jonathan Agg, MathWorks

Identify voiced speech

We can identify the transitions between voiced and unvoiced speech using changes in the power within the frequency band of interest.

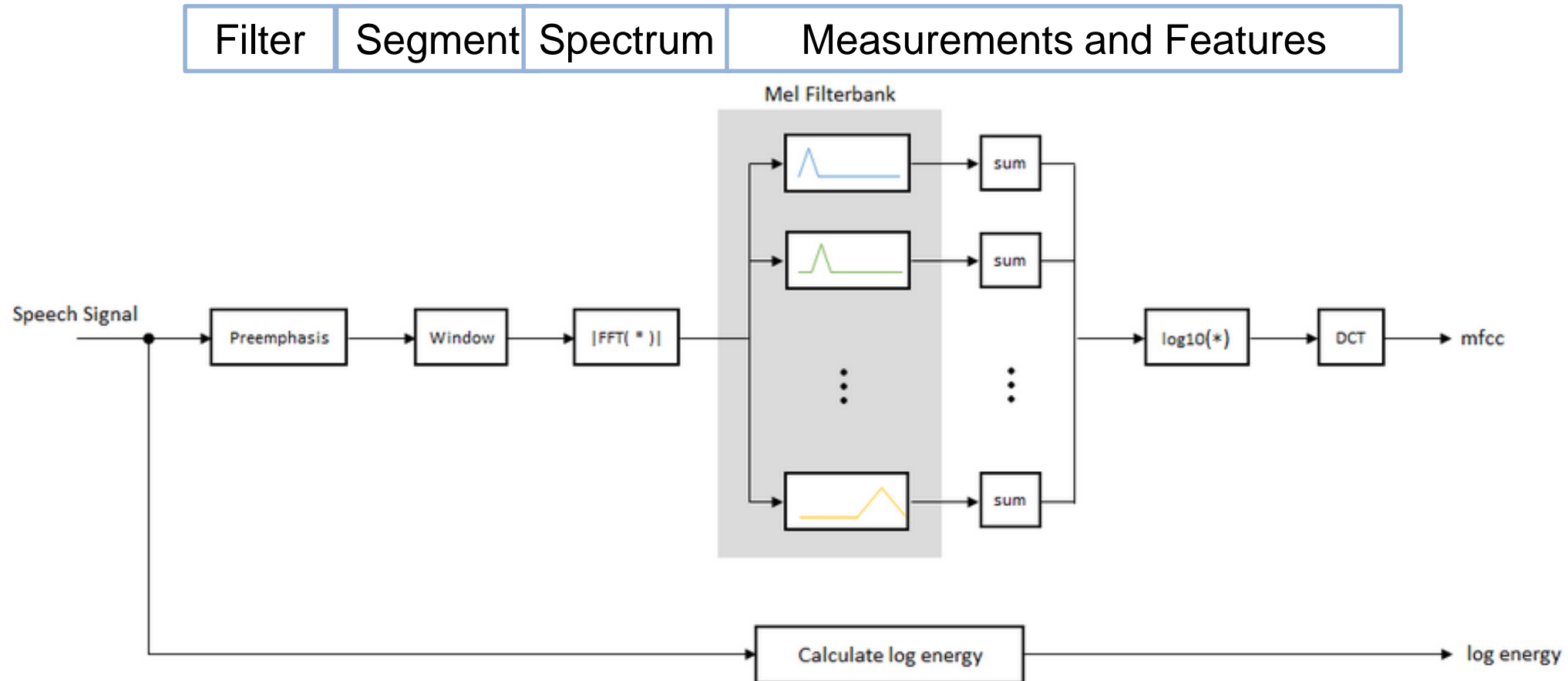
```
signalBuffer = buffer(signal,512,128);  
signalBand = bandpower(signalBuffer,fs,[0 5000]);  
changePts = findchangepts(signalBand,'MaxNumChanges',3);  
changeTimes = (changePts-1)*384/fs;  
timeLimits = changeTimes([1 2]); % seconds
```

signal	20480x1 double
signalBuffer	512x75 double



Speaker recognition algorithm

- Uses common techniques of filtering and spectral analysis to prepare data for measurements and feature extraction



Algorithm development workflow

- Interactive exploration of spectrum
- Generate code for automation
- Design filters based on specifications
- Extract features and measurements
- Moving from exploration to system models