

## Frames

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In this project, you will explore how to find a good system for analysis of particular data and learn to construct new systems. During the course of these, you will make use of the online tool `The IDR FrameNet Portal` .

### Level I. Comparison of wavelet systems

Use `The IDR FrameNet Portal` for the following analysis.

- (a) Consider 4 types of wavelet systems `DAUB8`, `BIOR 7/9`, `PS4-1typeI` and `splinefour` with the common property of approximation order 4. Choose several signals and decompose them using the given systems. The variety of signals should be large enough to draw a good conclusion. Find at least 3 different kind of signals for this experiment and explain what properties of the signals distinguish them. (If you try hard and still have difficulties in finding signals, contact your mentor.) Explain how the properties of the mother wavelets affect the analysis. For example, can you connect your experiments with the properties of the various highpass filters ? Now do the partial reconstruction of the decomposed signals. Can you detect any feature of your signals ? Discuss your observations and conclusions.
- (b) Using the system `RS4`, decompose the same signals as in part (a). How is the result different from part (a)? Now do the same reconstruction as you did in part (a). How is the result different from part (a)? What do you think makes the difference ?

### Level II. Construction of frames

Do the assignment for Level I and the following.

In class, you have learned the Unitary Extension Principle. In this project, you will learn the concept of the Oblique Extension Principle (OEP).

- (a) Using the OEP, construct 2 new tight frames with approximation order 4. You may want to write a MATLAB function `CheckIfTightOEP` analogous to the function `CheckIfTight` from Assignment #4b. Compare properties of your new systems with those in part (a) of Level I.
- (b) Add tight frames in part (a) into `The IDR FrameNet Portal` . Analyze the same signals as in Level I with your new systems. That is, do the decomposition and partial reconstruction of the signal with new systems. Compare and discuss the results.

*For both Level I and Level II, you need to find signals that lead you to an interesting conclusion. We will use it as one of the grading criteria.*

### **Level III. The Fast Wavelet Transform for OEP systems**

Do the assignment for Level I, II and the following.

In class, you have learned the Fast Wavelet Transform for UEP systems. In this project you will implement both the decomposition and reconstruction algorithm of the Fast Wavelet Transform for OEP systems.

- (a) Write a MATLAB function `fw_t_oe_p`, which performs one level of decomposition of the Fast Wavelet Transform for the wavelet system satisfying OEP that you studied in LEVEL II. Write a MATLAB function `ifw_t_oe_p` which performs one level of reconstruction of the Fast Wavelet Transform for OEP systems. Write a MATLAB code for the full decomposition and reconstruction using OEP systems.
- (b) Download the signals you used in Level I from [The IDR FrameNet Portal](#) and perform the analysis using the MATLAB code you implemented in part (a). Use the systems you made in part (a) of Level II. How do your results compare to part (b) of Level II ? If you find any difference in those results, explain the possible reasons.

**For all the levels, write a detailed description of your experiments stating what type of input data you had, what the output of your experiments, and your own conclusions. Turn in the report, along with your MATLAB code that you used for this project.**