

Homework Assignment II

Reading Assignment: Lecture Notes; Strang-Nguyen Chapter 3, Section 4.1-4.2;

1. An input signal $x[n]$ with triangular frequency spectrum is passed through a 2-channel maximally-decimated filter bank with ideal filters as depicted in Figure 1.
 Sketch the signal spectrum at every node. Show graphically that perfect reconstruction can be achieved.

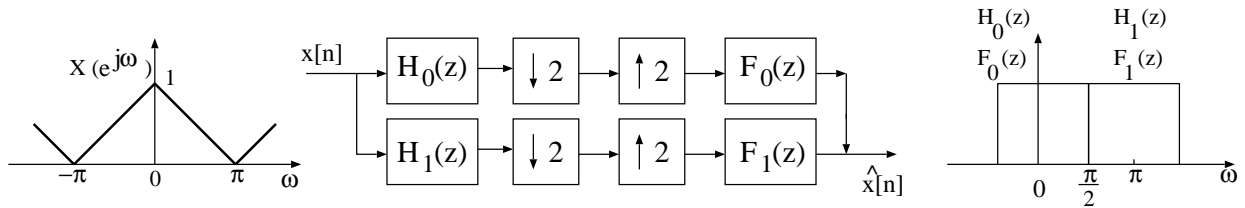


Figure 1: Two-channel filter bank with ideal filters.

2. Suppose that we have four filters $H_0(z)$, $H_1(z)$, $F_0(z)$, and $F_1(z)$ forming a perfect-reconstruction 2-channel filter bank. Investigate the possibility of achieving perfect reconstruction in the following cases.
 - (a) Interchange $F_i(z)$ with $H_i(z)$, i.e., using the synthesis filters as analysis filters and vice versa.
 - (b) Modulating all filters, i.e., replacing $H_i(z)$ with $H_i(-z)$ and $F_i(z)$ with $F_i(-z)$.
 - (c) Delaying the synthesis low-pass filter by D , i.e., replacing $H_0(z)$ by $z^{-D}H_0(z)$ and modifying $F_1(z)$ accordingly.

Due date: **Friday 09/21/2017** in class