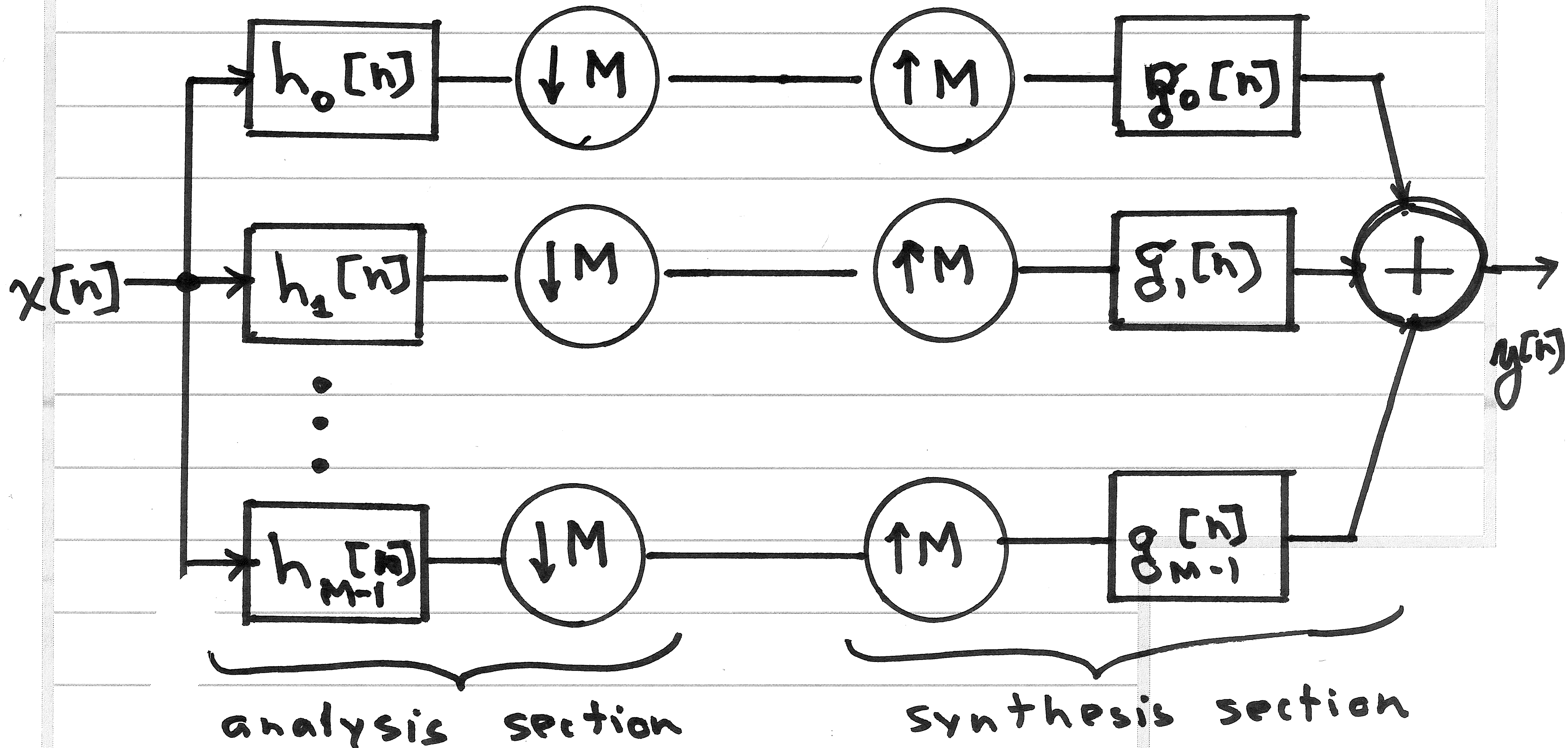
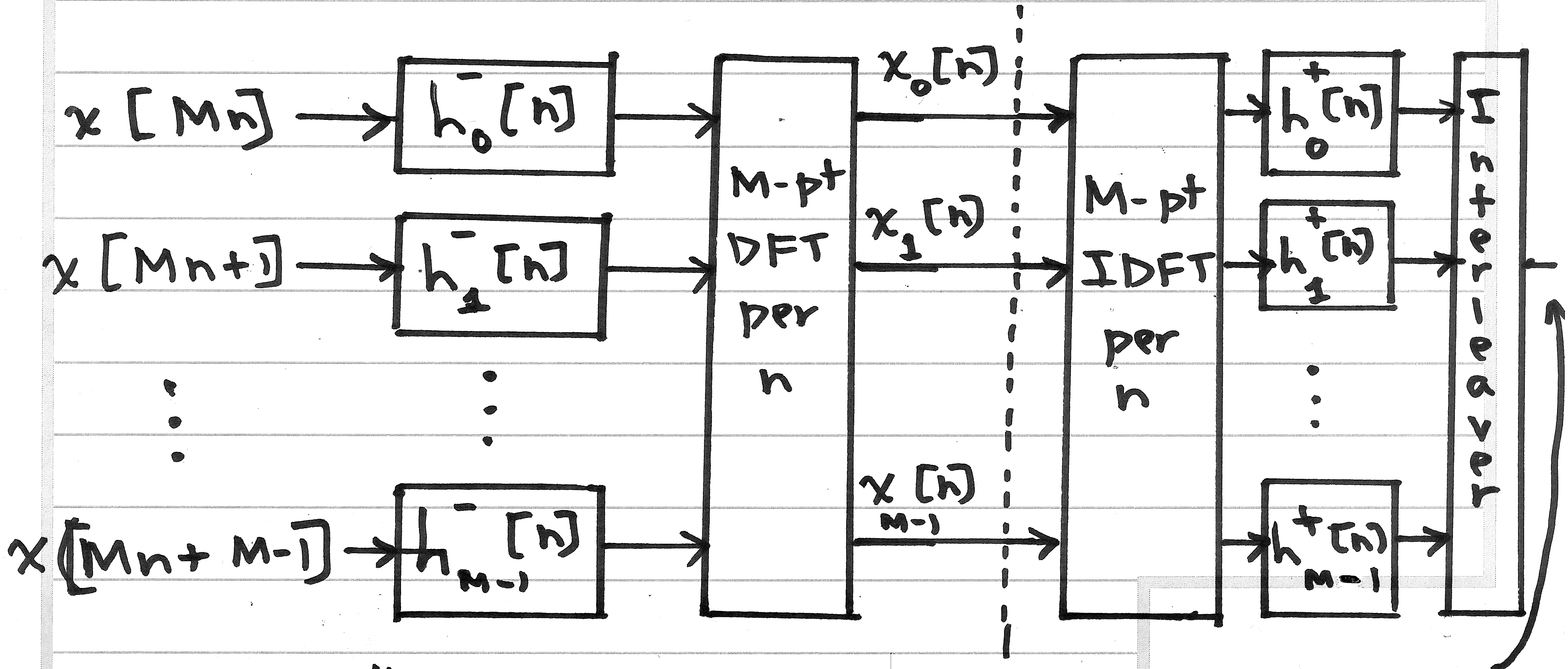
Perfect Reconstruction Filter Banks (PRFB)

- Text Sect 11.11
- From one viewpoint, a PRFB is a transmultiplexer with the left and right sides reversed, now called synthesis and analysis sections
  - that changes everything since the analysis and synthesis sections (which are in series) do not commute
    - zero-inserters and decimators are not LTI
      - they are linear but no TI
    - maximal decimation leads to aliasing
      - decimating by a factor equal to the number of subbands the signal is decomposed into



- If $g_m[n] = h_M[n] = e^{jm\frac{2\pi}{M}n}\, h_0[n]$, $m = 0, 1, \dots, M-1$ with $h_0[n]$ = LPF passing $(-\pi/M, \pi/M)$ then PRFB is a transmultiplexer with 2 "sides" reversed

• Efficient Implementation



"deinterleaver"

$y[n]$
desire $= x[n]$

• where: $h_m^-[n] = h_{LP}[Mn-m]$

$m = 0, 1, \ldots, M-1$

$h_m^+[n] = h_{LP}[Mn+m]$

$h_0[n] = h_{LP}[n] =$ LPF passing $(-\pi/M, \pi/M)$

- In this course, we will only consider subbands of equal width

- Dyadic case of subbands of unequal widths leads to wavelets
  - unequal widths take advantage of the logarithmic response of our ears as a function of frequency

- The primary application of PRFBs is subband coding for audio compression
    - Denoising is another big application
- The no. of bits per sample at the output of each subband varies according to the energy in that subband and the response of our ears over that frequency band
- Ultimately, the total no. of bits required to reconstruct the audio signal with "decent" fidelity is reduced => compression!
- But to reduce the no. of bits, must decimate each subband output by a factor equal to the no. of subbands (maximal decimation)
    - leads to aliasing effects w/ real-world filters