Chapter 5

- On page 96, at bottom of page insert paragraph:

We will continue our example by adding atmospheric loss. We assume the L-band radar is a long-range search radar that operates out to about 500 km. Because of its long operating range, we assume the elevation angles of interest are in the range of 1 degree. With this, the two-way atmospheric attenuation at 500 km will be about 1.8 dB (see Figure 5.7). At shorter ranges it will be less. For example, at 200 km, the two-way attenuation will be about 1.6 dB. We will use a compromise value of 1.7 dB.

- On page 103, Table 5.9, under Taylor weighting. The over lines should be over the \( n \), not to the right.
- On page 104, 3rd paragraph, Table 5.9 should be Table 5.7.

Chapter 7

- Code for MSCA CFAR function, Figure 7.21, and Figure 7.22 updated. There were some misplaced 2s, and separation should be 2, not 6. Extended target behavior more closely resembles that of a clutter region. Updated figures below:
Figure 7.21 MSCA-CFAR example – single run.

Figure 7.22 MSCA-CFAR example – 2000 ensembles.

- On page 200, exercise numbers 5 and 6 should not be duplicated.

Chapter 8
- On page 224: The first problem is not in line with the other problems (not all are left-justified)

Chapter 22
- On page 614, Equation (22.52), which has typos on second line, should be
\[ OIP3_C = OIP3_2 - 10\log \left( 1 + \frac{1}{G_2} \cdot \frac{OIP3_2}{OIP3_1} \right) \]

\[ = 18.5 - 10\log \left( 1 + \frac{1}{0.282} \cdot \frac{0.0708}{0.501} \right) \]

\[ = 16.74 \text{ dBm} \]
EQUATION 10.35 CLARIFICATION/ERRATA – M. BUDGE – NOVEMBER 2020

In reviewing Equation 10.35 [1], we realized it was not correct. That equation is

\[
\mathcal{F} \left[ \chi (\tau, f) \right] = \mathcal{F} \left[ \int_{-\infty}^{\infty} u(t) e^{j2\pi ft} v^*(t + \tau) d\tau \right] = \mathcal{F}^* \left[ u(\tau) e^{j2\pi f\tau} \right] \mathcal{F} \left[ v(\tau) \right]
\]  

(1)

where \( \mathcal{F} \) denotes the Fourier transform. The proper relation between the Fourier transforms is

\[
\mathcal{F} \left[ \chi^* (\tau, f) \right] = \mathcal{F} \left[ \left( \int_{-\infty}^{\infty} u(t) e^{j2\pi ft} v^*(t + \tau) d\tau \right)^* \right] = \mathcal{F}^* \left[ u(\tau) e^{j2\pi f\tau} \right] \mathcal{F} \left[ v(\tau) \right].
\]  

(2)

We now proceed to derive (2). We start by using the definition [1, Equation 10.34]

\[
\chi (\tau, f) = \int_{-\infty}^{\infty} u(t) e^{j2\pi ft} v^*(t + \tau) dt.
\]  

(3)

When we take the conjugate of (3) we get

\[
\chi^* (\tau, f) = \left( \int_{-\infty}^{\infty} u(t) e^{j2\pi ft} v^*(t + \tau) dt \right)^* = \int_{-\infty}^{\infty} u^*(t) e^{-j2\pi ft} v(t + \tau) dt.
\]  

(4)

We will make use of this extra step later. For now, we want to find the Fourier transform of \( \chi^* (\tau, f) \).

We start by making the substitution \( w(t) = u(t)e^{j2\pi ft} \). With that we have

\[
\chi^* (\tau, f) = \int_{-\infty}^{\infty} w^*(t) v(t + \tau) dt.
\]  

(5)

We next form the Fourier transform of \( \chi^* (\tau, f) \) as

\[
\mathcal{F} \left[ \chi^* (\tau, f) \right] = \int_{-\infty}^{\infty} \chi^* (\tau, f) e^{-j2\pi ft} d\tau = \int_{-\infty}^{\infty} \left( \int_{-\infty}^{\infty} w^*(t) v(t + \tau) dt \right) e^{-j2\pi ft} d\tau.
\]  

(6)

We make the change of variables \( x = t + \tau \) and replace the \( \tau \) variable of integration. This gives

\[
\mathcal{F} \left[ \chi^* (\tau, f) \right] = \int_{-\infty}^{\infty} \int_{-\infty}^{\infty} w^*(t) v(x) e^{-j2\pi f(x-t)} dt dx = \int_{-\infty}^{\infty} w^*(t) e^{j2\pi ft} \left( \int_{-\infty}^{\infty} v(x) e^{-j2\pi fx} dx \right) \]  

\[= \int_{-\infty}^{\infty} w(t) e^{-j2\pi ft} dt \left( \int_{-\infty}^{\infty} v(x) e^{-j2\pi fx} dx \right).
\]  

(7)

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We recognize the last two integrals as Fourier transforms. If we make the change of variables \( t = \tau \) in the first integral and the change of variables \( x = \tau \) in the second integral we get

\[
\Im \left[ \chi^* (\tau, f) \right] = \Im \left[ w(\tau) \right] \Im \left[ v(\tau) \right].
\]

We next replace \( w(\tau) \) with \( u(\tau)e^{j2\pi f \tau} \) to get

\[
\Im \left[ \chi^* (\tau, f) \right] = \Im \left[ u(\tau)e^{j2\pi f \tau} \right] \Im \left[ v(\tau) \right]
\]

which is the result indicated in (2).

We note that the error indicated in this paper does not affect the final formulation of the ambiguity function. Indeed, we have

\[
|\chi(\tau, f)|^2 = |\chi^* (\tau, f)|^2
\]

which means it doesn’t matter whether we use \( \chi(\tau, f) \) or \( \chi^* (\tau, f) \) to compute the ambiguity function. The advantage of using \( \chi^* (\tau, f) \) is that it makes the use of Fourier transforms easier to implement. Had we attempted to use Fourier transforms to compute \( \chi(\tau, f) \), the Fourier transform notation would have been somewhat cumbersome. Indeed, we can write

\[
\Im \left[ \chi(\tau, f) \right] = \int_{-\infty}^{\infty} \int_{-\infty}^{\infty} \int_{-\infty}^{\infty} \int_{-\infty}^{\infty} w(t)e^{-j2\pi \theta t} v(x)e^{-j2\pi \theta x} dx dt.
\]

With (11), we would need to interpret the integrals as inverse Fourier transforms, or as Fourier transforms as a function of \( -\theta \). Both of these would be somewhat cumbersome.

REFERENCE