---ERRATA, 1998 BOOK
FUNDAMENTALS OF ACOUSTICAL OCEANOGRAPHY
H Medwin and C.S. Clay, Academic Press 1998
ORIGINAL ERRATA-28 July 1999, Later Additions October 2000 AND LATER
Additional Medwin corrections 18March 2002
CHAPTER 1

   Page v of Table of Contents and Page 1 of the text,   Correct the
Chapter 1 Title to,
"Chapter 1 "The Realm of Acoustical Oceanography: Applications of Ocean
Acoustics".
   Running title for Chapter 1 remains the same.

Page xiv of Table of Contents, Correct the first line to
"12.2 The BTM Solution for Impulse Scatter from Wedges and Plates"

Plate 3.   Add reference. "See also, P.Rona et al, "Acoustic imaging of
hydrothermal flow regimes and coordination with in-situ sensors", EOS,
Trans. Am. Geophys. Union 81(48): F629, [2000]"

Page 1, line 4 Insert quotes and word "or" so that lines 3 and 4 read:
"One view, called "the forward problem" or "ocean acoustics", is in the
traditional direction -----"

Page 2,Section 1.2, second sentence, insert words
   "By contrast,because sound in sea water undergoes very much less
attenuation than electromagnetic waves, it has become the preeminent
tool for sensing, identifying, and communicating at great ranges under
the ocean surface."

Page 6, 5 lines from bottom, should read
"proposed ability to locate an explosion at sea by triangulation from
shore (delete solidus /)
listening stations."

Page 10, line 6, insert words to read
"These instruments, called SONARs (SOund NAvigation and Ranging) send
out and receive a sound beam, somewhat like a flashlight, but in pulses
or "pings" rather than continuously. The sonar can be pointed,
electronically, in any desired direction. The range is the product of
the average sound speed times half the travel time. Downward looking
sonars, "echo sounders", use the echo's travel time to calculate the
depth of the sea bottom beneath the ship."
Page 11, line 3, insert apostrophe "seafloor morphology in the 1980's."
Page 11, line 14, move Fig. 1.4.4 reference: "The massive numbers of
bubbles that are created by breaking waves do not lie in stratified
layers at the surface (Fig. 1.4.4). They have been traced by
acoustical backscatter to identify forms described as clouds, plumes
delete and Langmuir circulations."

Page 12, Fig. 1.4.3 caption, 3rd line corect the spelling,
"The sonar "fish" was"

Page 15 Fig. 1.4.6 caption. 4th line correct the spelling,
"neutrallly bouyant marine"

CHAPTER 2

Page   line or fig.or equation   Item
19   5.   correct grammar "We would have gotten an

increase---"
23   9   insert word "along the horizontal x axis"
26   after (2.3.5a)   insert words "is described for example by"
28   (2.4.1)   replace "e" by greek epsilon "e"
28   (2.4.2)   move exponent superscript to be W2 rather than W   2
29   caption line 3   insert words "have the amplitudes Pn at Q."
31   line 9   correct the subscript, change y3 to "y2"
31   (2.4.14)   correct the subscript,change R3 to "R2"
31   (2.4.15)   correct the subscript,change R3 to "R2"
34   below (2.4.28)   change the letter d to h "hydrophone is at shallow depth h « R"
35   Fig 2.4.3a   insert and correct words " in decibels after correction for free"
37   under (2.5.2a)   replace t by x after "The net force is
37   5 lines from bottom   replace t by x) in "flowing per unit time into the cage is --.
38   line 11   replace the reference to "Chapter 3" by
                                  "energy to be absorbed, as explained in Section 3.4.2".
46   lower Fig 2.6.3   Missing vertical ordinate line from 0 to 30 to 60 to 90 should be labeled,   either
                         Phase Angle, degrees or
                         Phase Angle, degrees or
                         Phase Angle, degrees
49   Fig 2.6.5 caption 4th line   change to subscript "h2 = 0.0025m", not h2
50   Title 2.6.4   Delete "RAY"
                         Correct title "REFLECTION BEYOND CRITICAL ANGLE"
54   Bottom of page Co-author spelling is "Brooke" not Brooks
55   last line of caption   add sentence "Other details in Medwin et al. (1988)."
57   four lines below (2.6.37)   Delete the word "to" "reflected signal is nearly zero".
60   two lines abouve (2.7.9)   correction "equation of state (2.5.5) to eliminate--"
61   equation(2.7.11)   correction third term should be bold "1" not 1.
61   equation (2.7.16)   correction third term should be bold "k" not k.
67   Prob. 2.4.1   correction"Verify equations (2.4.24) and (2.4.29)."
68   Prob 2.5.2   correction Line 1, "Equation (2.5.10) allows ....";
                         insertion Line 5 ,"Assume the ambient constants"
                         corrections Lines 5, 6, subscripts should be lower case "?a =
1.29 kg/m3, ca = 335 m/s "

CHAPTER 3
74   Eq (3.1.5)   corrections, ? should be "??in two places
74   Eq (3.1.6)   correction, ? should be "?? in one place
85   3 lines below Eq. (3.3.3)   corection-insertion "Often the ray angle is measured   with the horizontal and is called the "grazing

angle".

Defining the grazing angle as f, Snell's Law is then written
with cos f replacing sin ? in (3.3.3).

88   Under (3.3.21)   correction-insertion "where (abn)-1 is the radius in
                         the layer whose gradient is bn"
103   Eq. (3.4.4)   correction, In the exponent, replace t by "x"

110   Third Eq of (3.4.30)   bad typography; set f1 not f   1
110   Fourth Eq of (3.4.30)   correction Left side of eq should be"c =" ,
not q =
112   Above Eq. (3.4.38)   Insertion after "write",
                         "recalling the ray-path computations in Section 3.3.8",

114   Line 3   Add sentence "For example, standard sea level
pressure
is 1.013 x 105 Pa".
116   line 15   Insertion after "2484)"   ",with an introductory paper
                         by Munk and Baggeroer".
121   Fig. 3.6.1, 2nd line of caption Delete "at"

CHAPTER 4
134   Eq, (4.2.10a)   Replace,Summation S should be from n = 1 not n= 0
135   Eq (4.2.12)   Replace, The last parenthesis should be) not).
136   Figs 4.2.2 a), b), c), d)   Replace L by W , in abscissa, Figs a,b,c,d
137   Eq.(4.3.3)   Change [i(?t - ky sin?)] to read "(iky sin?)"
137   Eq. (4.3.6)   Insert parenthesis, (,before k in the numerator
139   first sentence Correct the spelling "and", not "aned"

CHAPTER 5
180   5 lines after (5.6.3)   Replace "x" by "8" ,   the multiplication
sign
181   line 1   Insert "where f is sound frequency; G = "

                         CHAPTER 6
190   Fig. 6.2.1.   b) Correction. Time steps go to "128" not 1 on right
                         e) Correction. Frequency goes to 128 not 12 on
right
191   Line 4 of Warning   Insert "Suggestion: Zero
pad to >8Tfor the duration   of a transient T,."

203   Eq. (6.4.1a) Left side.   Add subscript xx to read "cxx(k)"
204   Eq. 6.4.4.   Correct second summation indices to ""
                         where lower index is j = 1 and upper index is N
217   Fig 6.6.2 Caption, Line 5:   Correction. to read "(From W. W. L. Au",
219   line below Eq.(6.6.3)   Correction. to read "defined in Equation
4.5.4, and "
224   Caption Fig. 6.6.6, line 3   Correction. "propeller shafts" to read
"propellers"

226 -227 .Prob 6.1.1, from 3rd line.   Corrected MATLAB program.
                                         The correct code starting with "%
signal_cos_env; .is.

```
clear;  %        signal_cos_env; - a MatLab script file to display a ping
%       The envelope of the ping is 0.5*[1 - cos(2*pi*t./tp)]: Eq(6.3.1)
%       The carriers are sin(2*pi*Cf*t) or cos(2*pi*Cf*t)
%       In MatLab, % is a comment. The ; stops the printing of numbers to
the screen.

tp = 1;                                 % Duration of ping, s
Cf = 10;                                % Carrier frequency, Hz
```

```
Sf = 100;                                   % Sampling frequency, Hz
Ns = Sf*tp;                                 % Number of samples in time tp
t = linspace(0,tp,Ns);                      % create a time vector t with Ns elements
x = .5*(1-cos(2*pi*t./tp)).*sin(2*pi*Cf.*t);
        % vector x = term by term multiplication ".*". x has Ns elements
        % or x = .5*(1-cos(2*pi*t./tp)).*cos(2*pi*Cf.*t);
plot(t,x,'-w');                             % plot the signal versus t
xlabel('time, s');                          % label
ylabel('signal');                           % lable
title('ping')                               % title
```

     ****** end of revision to Prob 6.1.1. ************

Page 228   Line 4 after "Sections 6.2. and 6.3"
CORRECTED MATLAB PROGRAM.
                This code becomes

```
clear;  %          fft_signal; - a MatLab script file to display a ping and do a
fft
%       The envelope of the ping is 0.5*[1 - cos(2*pi*t./tp)]: Eq(6.3.1)
%       The carriers are sin(2*pi*f*t) or cos(2*pi*f*t)
%       In MatLab, the ; stops printing of numbers to the screen.

t0 = .01; fmax = 1/t0;                      % Sampling interval, s. fmax =1/t0
Ns = 128;                                   % Number of samples in time t1. 2^n
t1 = Ns*t0; f1=1/t1;                        % Duration of ping, s. Here tp = t1
Cf = 10; tp = t1;                           % Carrier frequency, Hz
t = linspace(0,t1-t0,Ns);                   % create a time vector t with Ns elements
f = linspace(0,fmax-f1,Ns);                 % create a freq vector f with Ns elements
x = .5*(1-cos(2*pi*t./tp)).*sin(2*pi*Cf.*t);
figure(1)                                   % Plot x as Figure 1
plot(t,x,'-w');                             % plot the signal versus t
xlabel('time, s');                          % label
ylabel('signal');                           % lable
title('ping')                               % title
figure(2)                                   % Plot fft as Figure 2
% fft of x
X = fft(x);
plot(f,abs(X),'-w');
xlabel('Frequency, Hz');
ylabel('|Spectrum|');
title('Spectrum of x')
```

**************** end of revision on page 228 **************

Page 229   Prob. 6.2.4 ,line 5   CORRECTED MATLAB
PROGRAM "% convl_examp; ..." becomes
```
clear;  % convl_examp;
% Give a pair of vectors, x and h and compute their convolution.
x = [1 2 3 4];                              % mx = 4
h = [.7 .3];                                % mh = 2
y = conv(x,h)                               % my = mx + mh - 1 = 5
% y = [.7 1.7 2.7 3.7 1.2]
```

**************** end of 6.2.4 revised code*******

Pages 229-230   Prob. 6.2.8, line 6   CORRECTED MATLAB PROGRAM
        "%   path_messages; ..." becomes
                        Page 4

```
clear; %           path_messages;
%           See Sec. 3.2 RAYPATHS, RAYTUBES, AND TRAVEL TIMES.
%           Raytraces give the travel time 'tpath' and signal amplitude 'paf'.
%           The impulse response is 'trPath'.  path can have many arrivals.
%           Here, the travel times and amplitudes of arrivals are assumed.
%           p(t) = conv(p0(t),path)

%           MATLAB requires that display vectors have the same number of
elements.

%           transmission path, 'trPath'
            tpath1 = .5;                    % 1st arrival travel time.
            paf1 = 1.5;                     % Amplitude
            tpath2 = .9;                    % 2nd arrival
            paf2 = -.8;                     % Amplitude
            t0 = .01;                       % Sampling interval
            tmax = 1;                       % Maximum duration of response
            ipath1 = round(tpath1/t0);      % 'round(.) nearest integer. time steps 1.
            ipath2 = round(tpath2/t0);      % time steps to arrival 2.
            imax = round(tmax/t0);   % Arbitrary maximum duration for the vector.
            trPath = zeros(1, imax);        % Create array of zeros
            trPath(ipath1) = paf1;          % Put first arrival in the array.
            trPath(ipath2) = paf2;          % and second arrival in.
            %        Message p0(t)          % Use exp(-st/Ts) , st is message time.
            Ts = .05;                       % time constant
            ns = round(4*Ts/t0);            % time steps, 4 time constants
            st = linspace(0,4*Ts,ns);       % Time vector for message
            p0 = exp(-st/Ts);               % Create a simple exp message.
            % Convolve the message p0(t) and trPath(t) to get p(t),
            %        the received message pressure.
            p = conv(p0,trPath);            % Convolution operation Sec. 6.2.5.
            ntot = ns + imax-1;             % Size of convolved vectors.
            t = linspace(0, ntot*t0,ntot);  % Create the vector t for plotting.
                        % Size t = size p.
            plot(t,p,'-w');
            xlabel('time, s');
            ylabel('p(t)');
            title('convolution of p0(t) and path(t)')
```

************* end of prob 6.2.8 revised code ********

Page 232   Section 6.4, line 5   CORRECTED MATLAB PROGRAM

        start line 5, "%   play_w_randn ... " becomes

```
clear; %           play_w_randn;
N = 1000;
y = randn(1,N);
for n = 1:N-1;                              % 'DO Loop or FOR-NEXT algorithm
        y(n+1) = y(n) +y(n+1);   % Do a running integration to smooth
end                                        % End of operation
x = linspace(0,N-1,N);
plot(x,y,'-w')
```

************ end revision**********

Page 233   Section 6.5 line 2   CORRECTED MATLAB PROGRAM

        line 2 "%   matched_filter..." becomes

```
clear; %           matched_filter;
```

```
N = 64;
x = randn(1,N);                        % x is the signal
h = fliplr(x);                                   % The matched filter is the time reverse of
x
zZ = zeros(1,N);                            % Create a vector of zeroes
x1 = [x zZ];                                % Add a string of zeroes to x
y =conv(x1,h);                        % Convolve x and its matched filter h
t = linspace(0,3*N,3*N-1);            % For plot
plot(t,y,'-w')
```

***************** end revision p 233

CHAPTER 7
236   lines 2.3   Change the word "incident"to have a lower case "i"
        and
add comparison.   Sentence should read
                    " The incident sound pressure, in a pseudo-continuous
        plane wave
analysis is assumed to be a ping having a   high carrier frequency f and
the duration tp >> f -1
236   3 lines below eq (7.1.1)   Insert after "theories". "See section
6.2.2"
238   Eqn.(7.1.11c)   Insert solidus, /, in front of Iinc to indicate
division.
246   4 lines below Eq(7.2.24)   Delete "not", it should read "plane
is
shown" .
277   Eqn.(7.5.29)   Change in numerator,   "kR" not "kr"
278   Eq.(7.5.34)   Change left side, it should be "pint" not "pinc"
279   3 lines from top   Insert "The radial particle velocity "
283   Fig. 7.5.5 ordinate   Correct the graph ordinate to use same
ordinate as in   Fig 7.5.4
284   Caption Fig 7.5.6   Add "The strong forward scattered lobe is
out of
phase   with, and is largely cancelled by, the incident wave."

CHAPTER 8
288   end of Paragraph , Four lines from bottom.Add "Also see The
Acoustic Bubble by T.G.   Leighton, Academic Press, 1994"
290   2nd line after the Fig 8.1.1   delete ka <1. substitute changes in
k.a.
290   5 lines from bottom   delete "an", substitute "the m = 0"
298   Fig. 8.2.1 bottom of caption   Add "See Medwin, H. (1977c)."

299   3 lines from bottom   Correct the reference,"Equation (8.2.28 a,b,c)"
300   Fig. 8.2.2 caption   Add reference Medwin,H., (1977b).
301   End of Figure caption   Add missing parenthesis, should be (1959)
311   under (8.3.2)   Insert word to read "For
time-integral-pressure-squared   [tips] processing"
316   ordinate of left figure Correct ordinate is se (m2) not ae (m2)
317   above (8.3.24) Insert "Eq.(8.2.39b)" after word "displacement",
                    and delete "Equation 8.2.39b)" at end of sentence.
317   in and below (8.3.24)   Correct the font, so that ?V (see second
term) is   used rather than ?? in the third term of (8.3.24)
and in
                    the line below (8.3.24)
320   eq (8.3.36)   Correct letter size in front of [ ] use same c0 as
                    c0after arrow, not big c0
321   5 lines above (8.3.39) Correct preposition, to read "and of water,
                    respectively"
322   7 lines from bottom   Period and Capitalize after "1970).   Several
cycles"
323   6th line of caption,Fig. 8.4.1 Correct reference "(See Medwin, H.,

1977, a, b, c)"
323   2nd line of caption, Fig. 8.4.2 Correct spelling "two echoes"
323   4th line of caption Fig. 8.4.2 Correct reference "See Medwin, H., 1970)".
326   Fig.8.4.4 caption.line 5   Correct to "Data at the two depths shown are for   changing air fractions-------etc"
326   Fig.8.4.4 caption.line 7   Delete the quotation sign " at end of sentence.
331   7th line of sec 8.4.4 Correct and supplement the references, "considered   by Medwin (1974), Medwin et al. 1975b and ---"
                    CHAPTER 9
349   Fig9.1.1caption,last line   Correct to "Also, swimbladder volumes range from 1   to 5 per cent of fish body volume".
353   6 lines above bottom   Correct "(1) Backscattering length is essentially"
355   line 11   Update to "fish. (Foote 1983 and Diachok 1999")

362   Second Line   Replacement, write "Plate 5" not Fig. 1.3.7
362   Line 5   Replacement, write "Fig.1.4.5" not Fig.1.3.8
362   Line 8   Replacement, write "Fig.1.4.6" not Fig.1.3.9

388   line 14   Add comment Nero, 1997. "Therefore the approximations
and simplifications in (9.5.19) may be   inadeuate".
396   End of Caption Fig.9.6.2   Add the reference " (From Stanton, T.K.et al. 1993)"
397   Fig.9.6.3 caption, line4   Correct reference is (From "Stanton, T.K., P.H.Wiebe, D.Chu, and L Goodman, "Acoustic characterization and
discrimination of marine   zooplankton and turbulence", ICES J. Marine
Sci. 5a1:   505-512 (1994)"
401 above section 9.8   Insert parentheses "Equation (8.2.13) Correct
spelling "range from about"

CHAPTER 10

    CHAPTER 11

474   Correct the font. The same font on left side of (11.1.19) etc on page 473 " ?m "   should have been used on page 474
    in
(11.1.22),(11.1.23), (11.1.24b), (11.1.25)
528   In text, 6 lines below (11.8.47)   Correct the exponential   "exp [-n? (?+ d)]"
529   (11.8.52b)   Correct the font, replace "T0" by "?w"
532   2 lines after "Density Contrast Wedges"   Correct spelling "separable"
535   Fig.(11.8.7)   Add "Time steps are 10 μs." after "suppressed"

CHAPTER 12
541   Outline, Line 2, Section 12.2   Change section title to
                        "12.2 The BTM Solution for Impulse Scatter from Wedges and Plates"
542   Section 12.2   Change section title to
                        "12.2 The BTM Solution for Impulse Scatter from Wedges and Plates"

544   (12.2.4)   Insert braces "{ "after cosh and "}"at end of equation
                        Correct brackets from (2rr0) to "[2rr0]"

547   Fifth line down Correct to "are calculated from equations in section   11.8.1"
552   (12.2.8a)   Correct upper limit of integral to "t0 + ?T / 2"
554   Section title,12.2.4 at top   Correct to
                        "12.2.4SIMPLIFYING APPROXIMATIONS"
555   3 lines from bottom   Add Sentence "this case. See Eq. (8)-(15) of
                        Medwin, Childs and Jebsen (1982) for details."
CHAPTER 13

596   Eq.13.2.6a   Insert before the equation, Rcoh=
                        (editor use same script R as in R12)
597   13.2.6b Change subscript to Rcoh instead of Rss
                        (editor use same script R as in R12)
601   Fig. 13.2.5 caption, last line   Insert, "--and an isotropic
Gaussian spatial --"
604   3 lines above the figure   Substitute "Additionally," to replace
"Inversely"
605   Second line   Correct text "(section 5.3.1)" rather than 5.4

CHAPTER 14

REFERENCES
679   References   Add: "Munk, W.; and A. Baggeroer " The Heard Island

                        papers: a contribution to global acoustics", J. Acoust.
                Soc. Am.
96, 2327 – 2329, (1994); see also 17 papers   pp. 2330 -2484"

        BIBLIOGRAPHY
688   Bibliography   Add "Baker, B.B. and E.T. Copson, TheMathematical
                        Theory of Huygens' Principle, Oxford, Press (1950)"
690   Bibliography   Add "Leighton, T.G., The Acoustic Bubble
        Academic
Press, (1994)"

SUBJECT INDEX
709   Subject Index   Add Inserts under "Doppler"
                                        "shift, 119"
                                "sonar, 411",
                                "velocimeter, 411"
709   Subject Index   Add Insert for new subject,
                "Helmholtz-Kirchhoff-Fresnel (HKF)method,249, 609"

710   Subject Index   Add Inserts
                        "Noise, see Sound"
                        Insert
                        "Sofar, 6, 71"
711   Subject Index   Correct page reference,
                        "Scattering cross section, differential 237", not 327

2 APRIL 2001
ADDENDUM TO 1 MARCH 2001 CORRECTIONS TO "F OF AO"

All Chapter Titles: Add an asterisk * after the title of each chapter
(on each chapter's title page).
                        Add footnote at bottom of chapter title
pages for Chapters 1,2, 4, 5, 8, 12, 13   *

Principal Author,   H. Medwin
Add footnote at bottom of chapter title pages for Chapters 3, 6,

7, 9, 10, 11, 14
* Principal Author, C. S. Clay
page 272   (Eq. 7.5.12)   Replace bold type by normal type.   Subscript R =
a   should be same size as R on left side of the equation
page 272   (Eq. 7.5.13)   Replace bold type by normal type.   Subscript R =
a   should be same size as R on left side of the equation
page 272   (Eq. 7.5.14)   Correct the R = a, should be small subscript of
Uscat]
It should read Uscat] R = a

page 326   Caption of Fig. 8.4.4   Replace on last line (Farmer et al,
1998)
instead of (D. Farmer, personal communication, 1997)
page 669   New Reference   Add
Farmer, D.M., S. Vagle, and A. D. Booth,
A free- flooding acoustical resonator for
measurement of
bubble size distributions,
J. Atmos. & Oceanic Technol.,15,
No. 5,   1132-1146. (1998)