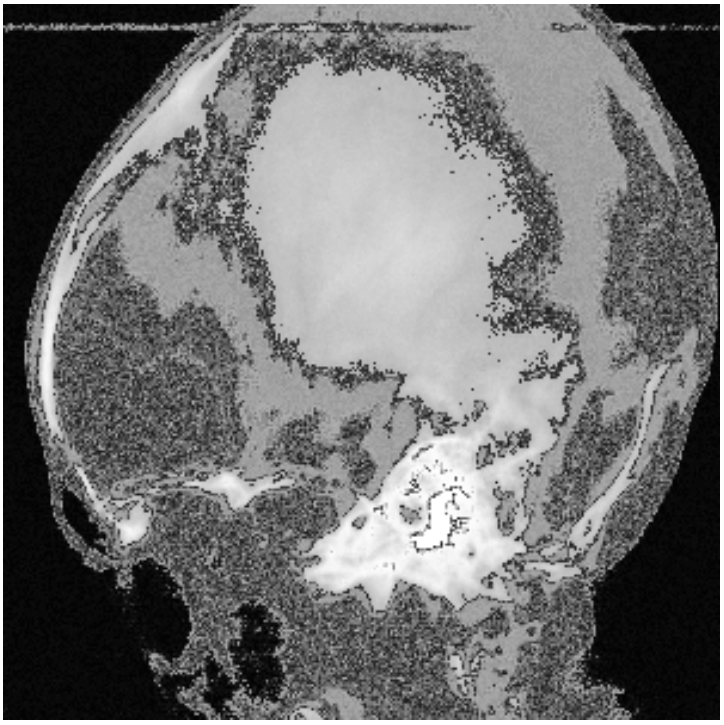
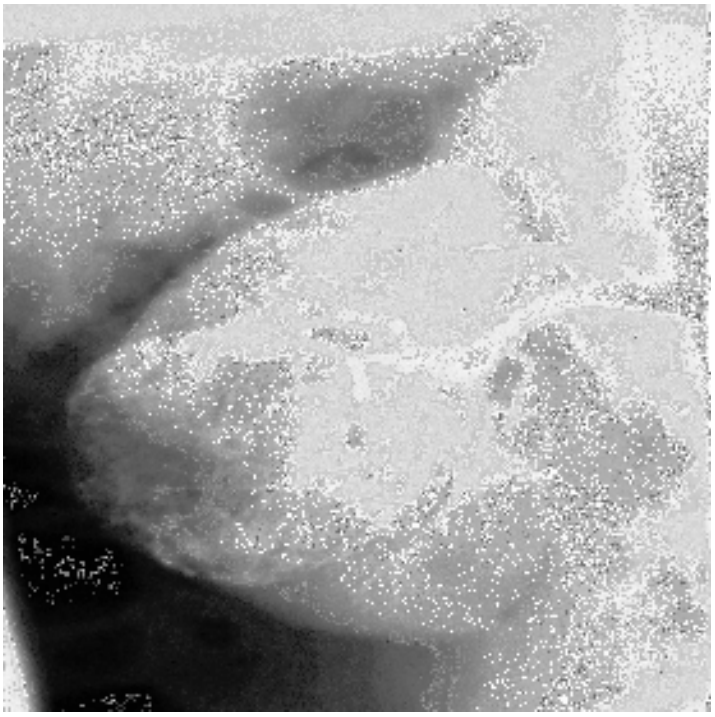
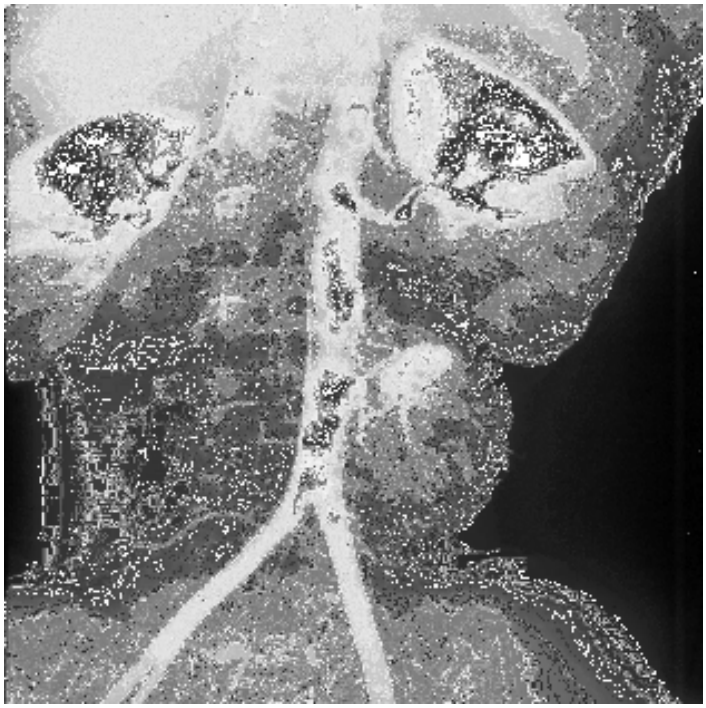
LAMPIRAN A
CITRA MEDIS YANG DIUJI



assesment after a road traffic accident.bmp (900 x 900)

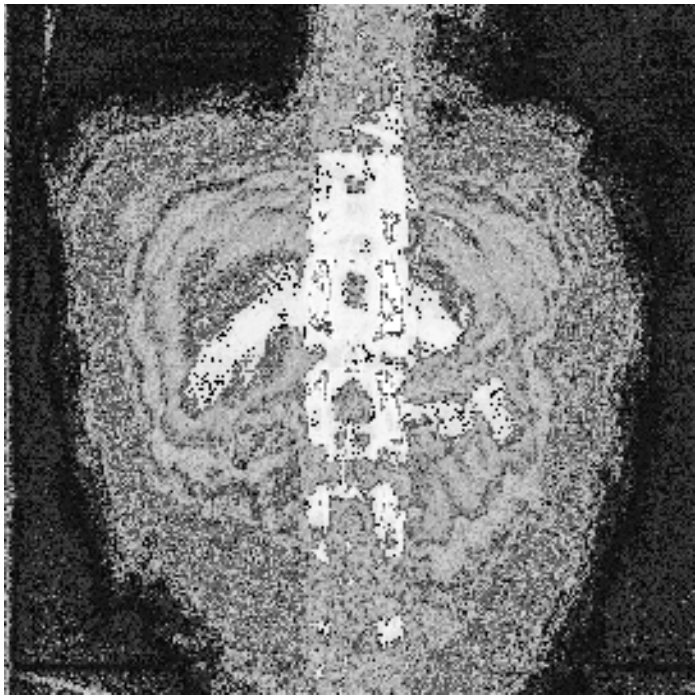


Xray.bmp (554 x 554)

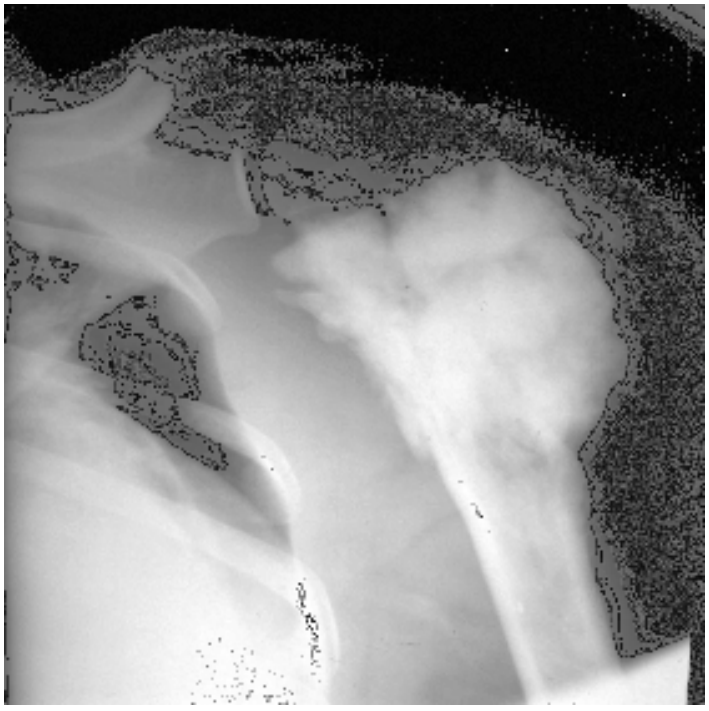


Young adult male with hypertension.bmp (628 x 628)

Abdominal mass.bmp (850 x 850)



Brought-up on a sheep farm.bmp (812 x 812)



discomfort in the left shoulder.bmp (562 x 562)

LAMPIRAN B
LISTING PROGRAM

Soft Thresholding

```
clear;
clc;
clear all;
close all;
display('          ');
display('          ');

display('          ');
display('             MEDICAL IMAGE DENOISING USING WAVELETS ');

display('          ');
display('          ');
display('          ');

display('          ');
display('          ');

display('pilihlah citra di bawah :');

display('          1:a patient with headache.jpg');
display('          2:xray.bmp');
display('          3:abdominal mass.bmp');
display('          4:abdominal pain & loose stool.bmp');
display('          5:assesment after a road traffic accident.bmp');
display('          6:Indian man with a alcohol problem.bmp');
display('          7:Brought-up on a sheep farm.bmp');
display('          8:discomfort in the left shoulder.bmp');
display('          9:retina.bmp');
display('          10:lutut.bmp');
display('          11:vague pain.bmp');
display('          12:pain in the right hip.bmp');
display('          13:sphenoid.bmp');
display('          14:Young adult male with hypertension..bmp');
display('          15:zgomaticrtfracture.bmp');
display('          ');


ss1=input('ketikkan nomor yang dipilih :   ');
switch ss1
   case 1
     f=imread('a patient with headache.jpg');
   case 2
      f=imread('xray.bmp');
   case 3
      f=imread('abdominal mass.bmp');
   case 4
      f=imread('abdominal pain & loose stool.bmp');
      case 5
      f=imread('assesment after a road traffic accident.bmp');
   case 6
      f=imread('Indian man with a alcohol problem.bmp');
   case 7
      f=imread('Brought-up on a sheep farm.bmp');
```

```
   case 8
      f=imread('discomfort in the left shoulder.bmp');
   case 9
      f=imread('retina.bmp');
   case 10
      f=imread('lutut.bmp');
   case 11
      f=imread('vague pain.bmp');
   case 12
      f=imread('pain in the right hip.bmp');
   case 13
      f=imread('sphenoid.bmp');
   case 14
      f=imread('Young adult male with hypertension..bmp');
   case 15
      f=imread('zgomaticrtfracture.bmp');
end

subplot(2,2,1), imshow(f);title('original image');

display('digunakan gaussian noise');


display('masukkan varience dari noise :  ');
va=input('ketikkan antara 0.01 hingga 0.09:   ');
g=imnoise(f,'gaussian',0,va);


subplot(2,2,2),imshow(g);title('noisy image');


x=g;
%memilih induk wavelet
[thr,sorh,keepapp] = ddencmp('den','wv',x);
display('');
display('pilihlah induk wavelet');
display('ketik 1 untuk haar wavelet');
display('ketik 2 untuk db4 wavelet');
display('ketik 3 untuk sym wavelet');
display('ketik 4 untuk bior wavelet');

display('ketik sembarang tombol untuk keluar');
display('');

ww=input('ketikkan nomor yang dipilih :    ');
switch ww
   case 1
      wv='haar';
   case 2
      wv='db4' ;
   case 3
      wv='sym4';
   case 4
     wv='bior6.8';
```

```
   otherwise
      quit;
end
display('');
display('soft thresholding')

display('masukkan level dekomposisi');
level=input(' ketikkan level dekomposisi :    ');


      sorh='s';
      xd = wdncmp('gbl',x,wv,level,thr,sorh,keepapp);

      %%%%%%%%%%%%%%%%%%%%%%

[c,s]=wavefast(g,level,wv);
subplot(2,2,3),wave2gray(c,s,8);title('decomposed structure');


subplot(2,2,4),xd=uint8(xd);
imshow(xd);title('denoised image');

ff=im2double(f);xdd=im2double(xd);
display('      ');
display('      ');
display('Rachma Putri Andilla');
display('0522028');
display('Denoising medical image using Soft Thresholding');
display('2009');
display('      ');
display('      ');
snr=psnr(ff,xdd)

display('      ');
display('      ');
mse=compare11(ff,xdd)
```

Hard Thresholding

```
clear;
clc;
clear all;
close all;
display('          ');
display('          ');

display('          ');
display('             MEDICAL IMAGE DENOISING USING WAVELETS ');

display('          ');
display('          ');
```

```
display('          ');

display('          ');
display('          ');

display('pilihlah citra di bawah :');

display('          1:a patient with headache.jpg');
display('          2:xray.bmp');
display('          3:abdominal mass.bmp');
display('          4:abdominal pain & loose stool.bmp');
display('          5:assesment after a road traffic accident.bmp');
display('          6:Indian man with a alcohol problem.bmp');
display('          7:Brought-up on a sheep farm.bmp');
display('          8:discomfort in the left shoulder.bmp');
display('          9:retina.bmp');
display('          10:lutut.bmp');
display('          11:vague pain.bmp');
display('          12:pain in the right hip.bmp');
display('          13:sphenoid.bmp');
display('          14:Young adult male with hypertension..bmp');
display('          15:zgomaticrtfracture.bmp');
display('          ');


ss1=input('ketikkan nomor yang dipilih :   ');
switch ss1
   case 1
     f=imread('a patient with headache.jpg');
   case 2
      f=imread('xray.bmp');
   case 3
      f=imread('abdominal mass.bmp');
   case 4
      f=imread('abdominal pain & loose stool.bmp');
      case 5
      f=imread('assesment after a road traffic accident.bmp');
   case 6
      f=imread('Indian man with a alcohol problem.bmp');
   case 7
      f=imread('Brought-up on a sheep farm.bmp');
   case 8
      f=imread('discomfort in the left shoulder.bmp');
   case 9
      f=imread('retina.bmp');
   case 10
      f=imread('lutut.bmp');
   case 11
      f=imread('vague pain.bmp');
   case 12
      f=imread('pain in the right hip.bmp');
   case 13
      f=imread('sphenoid.bmp');
   case 14
      f=imread('Young adult male with hypertension..bmp');
```

```
   case 15
      f=imread('zgomaticrtfracture.bmp');
end

subplot(2,2,1), imshow(f);title('original image');

display('digunakan gaussian noise');



display('masukkan varience dari noise :  ');
va=input('ketikkan antara 0.01 hingga 0.09:   ');
g=imnoise(f,'gaussian',0,va);

subplot(2,2,2),imshow(g);title('noisy image');


x=g;
%memilih induk wavelet
[thr,sorh,keepap] = ddencmp('den','wv',x);
display('');
display('pilihlah induk wavelet');
display('ketik 1 untuk haar wavelet');
display('ketik 2 untuk db4 wavelet');
display('ketik 3 untuk sym wavelet');
display('ketik 4 untuk bior wavelet');

display('ketik sembarang tombol untuk keluar');
display('');

ww=input('ketikkan nomor yang dipilih :    ');
switch ww
   case 1
      wv='haar';
   case 2
      wv='db4' ;
   case 3
      wv='sym4';
   case 4
     wv='bior6.8';

   otherwise
      quit;
end
display('');
display('hard thresholding')

display('masukkan level dekomposisi');
level=input(' ketikkan level dekomposisi :    ');


      sorh='h';
      xd = wdencmp('gbl',x,wv,level,thr,sorh,keepapp);

      %%%%%%%%%%%%%%%%%%%%%
```

```
[c,s]=wavefast(g,level,wv);
subplot(2,2,3),wave2gray(c,s,8);title('decomposed structure');


subplot(2,2,4),xd=uint8(xd);
imshow(xd);title('denoised image');

ff=im2double(f);xdd=im2double(xd);
display('      ');
display('      ');
display('Rachma Putri Andilla');
display('0522028');
display('Denoising medical image using Hard Thresholding');
display('2009');
display('      ');
display('      ');
snr=wpsnr(ff,xdd)

display('      ');
display('      ');
mse=compare11(ff,xdd)
```

MPTH

```
clear;
clc;
clear all;
close all;
display('          ');
display('          ');

display('          ');
display('             MEDICAL IMAGE DENOISING USING WAVELETS ');

display('          ');
display('          ');
display('          ');

display('          ');
display('          ');

display('pilihlah citra di bawah :');

display('          1:a patient with headache.jpg');
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display('          5:assesment after a road traffic accident.bmp');
display('          6:Indian man with a alcohol problem.bmp');
display('          7:Brought-up on a sheep farm.bmp');
display('          8:discomfort in the left shoulder.bmp');
display('          9:retina.bmp');
```

```
display('          10:lutut.bmp');
display('          11:vague pain.bmp');
display('          12:pain in the right hip.bmp');
display('          13:sphenoid.bmp');
display('          14:Young adult male with hypertension..bmp');
display('          15:zgomaticrtfracture.bmp');
display('          ');


ss1=input('ketikkan nomor yang dipilih :   ');
switch ss1
   case 1
      f=imread('a patient with headache.jpg');
   case 2
      f=imread('xray.bmp');
   case 3
      f=imread('abdominal mass.bmp');
   case 4
      f=imread('abdominal pain & loose stool.bmp');
      case 5
      f=imread('assesment after a road traffic accident.bmp');
   case 6
      f=imread('Indian man with a alcohol problem.bmp');
   case 7
      f=imread('Brought-up on a sheep farm.bmp');
   case 8
      f=imread('discomfort in the left shoulder.bmp');
   case 9
      f=imread('retina.bmp');
   case 10
      f=imread('lutut.bmp');
   case 11
      f=imread('vague pain.bmp');
   case 12
      f=imread('pain in the right hip.bmp');
   case 13
      f=imread('sphenoid.bmp');
   case 14
      f=imread('Young adult male with hypertension..bmp');
   case 15
      f=imread('zgomaticrtfracture.bmp');
end


image=double(f);
[n,nn]=size(image);
%%%%%%%%%%%%%%%%

subplot(1,3,1)
imshow(image,[0 255]);title('original image')
%%%%%%
pimage=mean(mean(image.^2));
v=28;
noi=v*randn(n,n);
snr_o=10*log10(pimage/v^2)  %%original SNR
```

```
sca=3;
imagn=image+noi;
[wr,wc,ss,m]=wt2d(imagn,sca);
[corr,corc]=compcor2d(wr,wc);

%%%%%%%%%%%%%%%%%%
rima=th_w2d(wr,wc,ss,v,m);

subplot(1,3,2)
imshow(rimat,[0 255]);title('noisy image')

errt=image-rimat;
perrt=mean(mean(errt.^2));
snr_ft=10*log10(pimage/perrt);
%%%%%%%%%%%%%%%%%%%%

%%%% the scale correlation thresholding
[sca,n,nn]=size(wr);

th=getth2d(sca);
c=15;
for i=1:sca-1
  wrt=reshape(wr(i,:,:),n,n);
  corrt=reshape(corr(i,:,:),n,n);
  mask=(corrt>c*v^2*th(i));
  iwr(i,:,:)=wrt.*mask;

  wct=reshape(wc(i,:,:),n,n);
  corct=reshape(corc(i,:,:),n,n);
  mask=(corct>c*v^2*th(i));
  iwc(i,:,:)=wct.*mask;
end

nf=nomf2d(sca);
wrt=reshape(wr(sca,:,:),n,n);
iwr(sca,:,:)=wrt.*(abs(wrt)>3.*v*nf(sca));
wct=reshape(wc(sca,:,:),n,n);
iwc(sca,:,:)=wct.*(abs(wct)>3.*v*nf(sca));

rima=iwt2d(iwr,iwc,ss,m);

err=image-rima;
perr=mean(mean(err.^2));
snr_f=10*log10(pimage/perr) %% SNR setelah scale correlation thresholding

subplot(1,3,3)
imshow(rima,[0 255]);title('denoised image')



function [c,s]=wavefast(x,n,varargin)
error(nargchk(3,4,nargin));
if nargin==3
   if ischar(varargin{1})
```

```
    [lp,hp]=wavefilter(varargin{1},'d');
  else

  end
else
  lp=varargin{1}; hp=varargin{2};
end
fl=length(lp);sx=size(x);
if (ndims(x)~=2) | (min(sx)<2) | ~isreal(x) | ~isnumeric(x)
  error('X must be a real ,numeric matric.');
end
if(ndims(lp)~=2) | ~ isreal(lp) | ~isnumeric(lp) | (ndims(hp) ~=2) | ~ isreal(hp) | ~isnumeric(hp) ...
    | (fl~=length(hp)) | rem(fl,2)~=0
  error(['LP and HP harus sama dengan panjang vector.']);
end
if ~isreal(n) | ~isnumeric(n) |(n<1) |(n>log2(max(sx)))
  error(['N harus diatara 1 dan log2(max(size(X))).']);
end
c=[];s=sx;app=double(x);
for i=1:n
  [app,keep]=symextend(app,fl);
  rows=symconv(app,hp,'row',fl,keep);
  coefs=symconv(rows,hp,'col',fl,keep);
  c=[coefs(:)' c]; s=[size(coefs);s];
  coefs=symconv(rows,lp,'col',fl,keep);
  c=[coefs(:)' c];
  rows=symconv(app,lp,'row',fl,keep);
  coefs=symconv(rows,hp,'col',fl,keep);
  c=[coefs(:)' c];
  app=symconv(rows,lp,'col',fl,keep);
end
c=[app(:)' c]; s=[size(app);s];
function [y, keep]=symextend(x,fl)
keep=floor((fl+size(x)-1)/2);
y=padarray(x,[(fl-1) (fl-1)],'symmetric','both');
function y=symconv(x,h,type,fl,keep)
if strcmp(type, 'row')
  y=conv2(x,h);
  y=y(:,1:2:end);
  y=y(:,fl/2+1:fl/2+keep(2));
else
  y=conv2(x,h');
  y=y(1:2:end,:);
  y=y(fl/2+1:fl/2+keep(2),:);
end



function f = WPSNR(A,B,varargin)

        if A == B
        error('Images are identical: PSNR has infinite value')
        end

        max2_A = max(max(A));
```

```
        max2_B = max(max(B));
        min2_A = min(min(A));
        min2_B = min(min(B));

        if max2_A > 1 | max2_B > 1 | min2_A < 0 | min2_B < 0
        error('input matrices must have values in the interval [0,1]')
        end

        e = A - B;
        if nargin<3
                fc = csf;
        else
                fc = varargin{1};
        end
        ew = filter2(fc, e);

        decibels = 20*log10(1/(sqrt(mean(mean(ew.^2)))));
        f=decibels;

%============
function fc = csf()
%============

        Fmat = csfmat;

        fc = fsamp2(Fmat);
        %mesh(fc)


%======================
function Sa = csffun(u,v)
%======================
        sigma = 2;
        f = sqrt(u.*u+v.*v);
        w = 2*pi*f/60;
        Sw = 1.5*exp(-sigma^2*w^2/2)-exp(-2*sigma^2*w^2/2);

        sita = atan(v./(u+eps));
        bita = 8;
        f0 = 11.13;
        w0 = 2*pi*f0/60;
        Ow = ( 1 + exp(bita*(w-w0)) * (cos(2*sita))^4) / (1+exp(bita*(w-w0)));
        Sa = Sw * Ow;


%==================
function Fmat = csfmat()
%==================
        min_f = -20;
        max_f = 20;
        step_f = 1;
        u = min_f:step_f:max_f;
        v = min_f:step_f:max_f;
        n = length(u);
        Z = zeros(n);
```

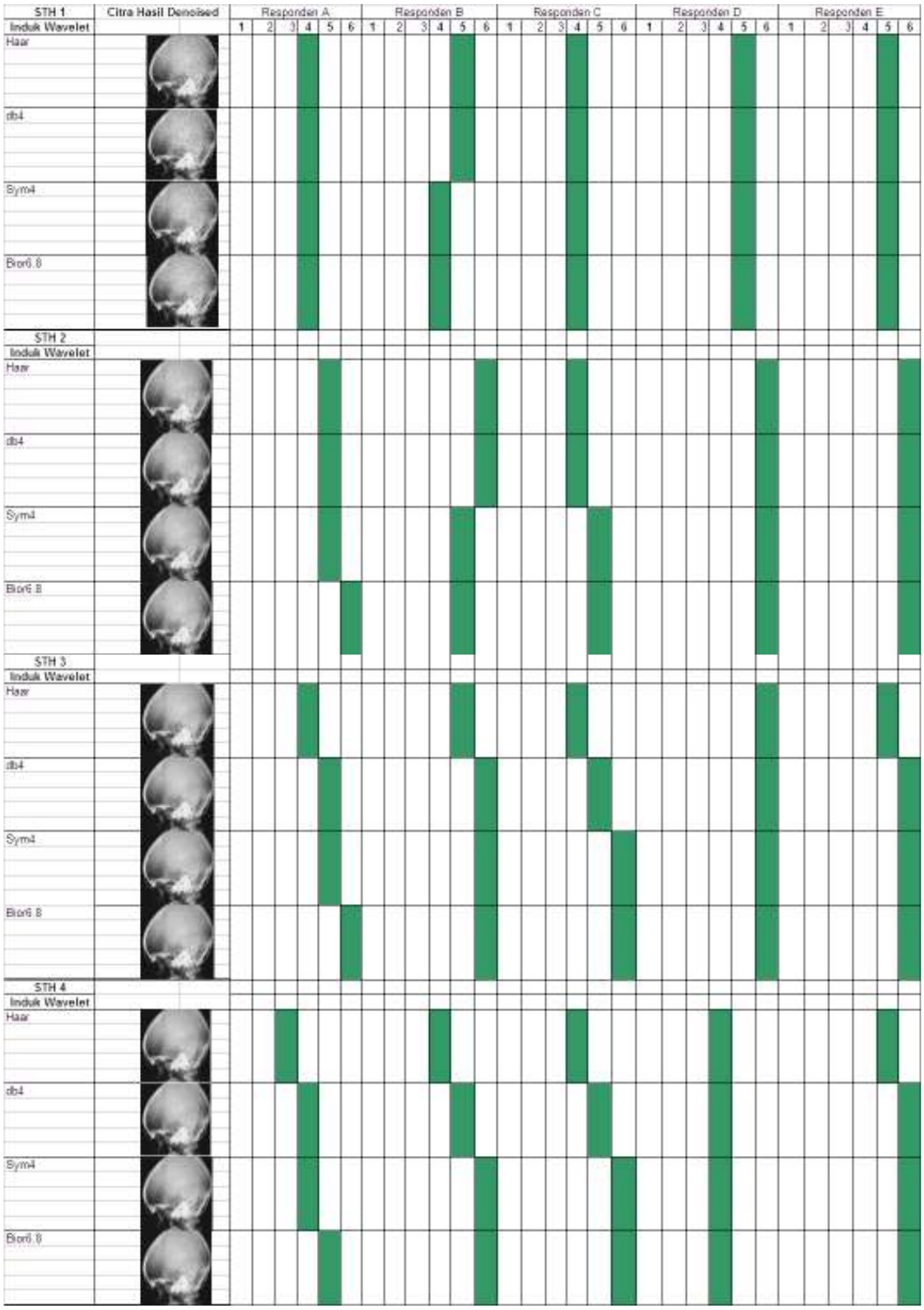
```
        for i=1:n
                for j=1:n
                        Z(i,j)=csffun(u(i),v(j));
                end
        end
        Fmat = Z;



function rmse=compare11(f1,f2,scale)
%%%%%%%%%%%%%%%%%%%%

error(nargchk(2,3,nargin));
if nargin<3
   scale=1;

end
%%%%%%%%%%%%%%%%
%menghitung root mean square error
e=double(f1)-double(f2);
[m,n]=size(e);
rmse=sqrt(sum(e(:).^2)/(m*n));
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
if rmse
   %%%%%%%%%%%%%%%%
   emax=max(abs(e(:)));
   [h,x]=hist(e(:),emax);
   if length(h)>=1
      %figure,bar(x,h,'k');
      %%%%%%%%%%%%%%%%%%
      emax=emax/scale;
      e=mat2gray(e,[-emax, emax]);

   end
end



function [wwr,wwc,ss,m]=wt2d(image,sca)

%%%2D dyanic wavelet transform%%%%%%%%%%

J=sca;
[n,m]=size(image);
if m>64
  m=64;
end

%%%%%%%%reform the image%%%%%%%%%%%%%%%%
ima=zeros(2*m+n,2*m+n);
ima(m+1:m+n,:)=[image(:,m:-1:1) image image(:,n:-1:n-m+1)];
ima(1:m,m+1:m+n)=image(m:-1:1,:);
```

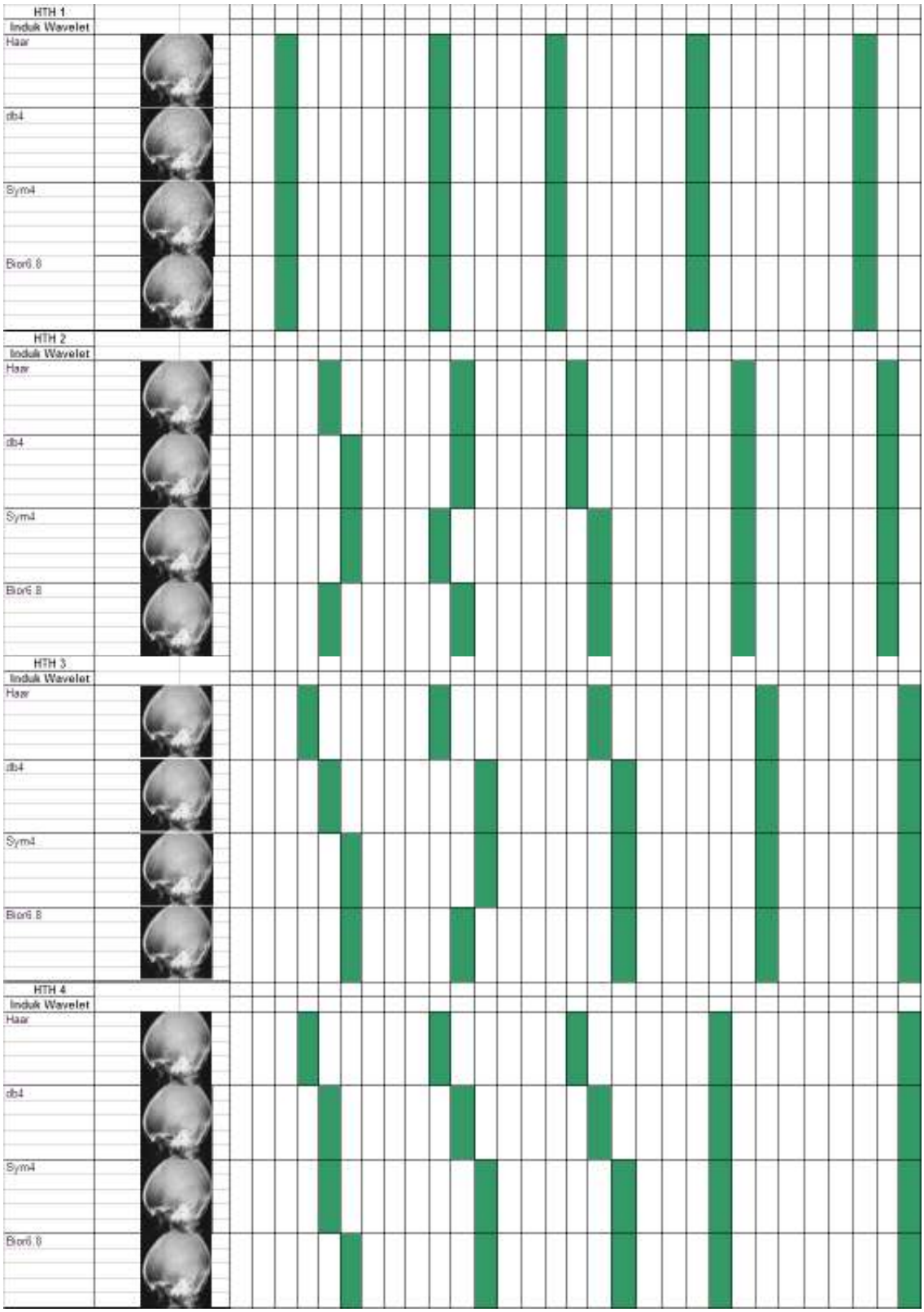
```
ima(m+n+1:2*m+n,m+1:m+n)=image(n:-1:n-m+1,:);
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
clear image;

j=0;
while j<J
   rt=conv2(ima,getg(j));
   wwr(j+1,:,:)=rt(:,128:128+n+2*m-1);
   ct=conv2(ima,getg(j)');
   wwc(j+1,:,:)=ct(128:128+n+2*m-1,:);

   st=conv2(ima,geth(j));
   st=st(:,128:128+n+2*m-1);
   ima=conv2(st,geth(j)');
   ima=ima(128:128+n+2*m-1,:);
   j=j+1;
end

ss=ima;

return;



function [corr,corc]=compcor2d(wr,wc)

%%%%%menghitung correlation of w%%%%%%%%%

%wr,wc----koefisien wavelet

[sca,n,nn]=size(wr);

corr=zeros(sca-1,n,nn);
corc=corr;

for i=1:sca
   taor(i)=2^(i-1);
end

  taoc=[0 taor];


for i=1:sca-1
   twr1=reshape(wr(i,:,:),n,n);
   ttwr2=reshape(wr(i+1,:,:),n,n);
   twr2=zeros(n,n);
   twr2(1:n-taoc(i),1:n-taor(i))=ttwr2(1+taoc(i):n,1+taor(i):n);
   corr(i,:,:)=twr1.*twr2;

   twc1=reshape(wc(i,:,:),n,n);
   ttwc2=reshape(wc(i+1,:,:),n,n);
   twc2=zeros(n,n);
   twc2(1:n-taor(i),1:n-taoc(i))=ttwc2(1+taor(i):n,1+taoc(i):n);
   corc(i,:,:)=twc1.*twc2;
```

```
end



function rimat=th_w2d(wr,wc,ss,v,m)

[sca,n,nn]=size(wr);
nf=normf2d(sca);

for i=1:sca
   wrt=reshape(wr(i,:,:),n,n);
   mask=(abs(wrt)>3.1*v*nf(i));
   iwr(i,:,:)=wrt.*mask;

   wct=reshape(wc(i,:,:),n,n);
   mask=(abs(wct)>3.1*v*nf(i));
   iwc(i,:,:)=wct.*mask;
end

rimat=iwt2d(iwr,iwc,ss,m);



function tth=getth2d(sca)


nf=normf2d(sca+1);
[sigma_z1,sigma_z2]=getsigma2d(sca);

for i=1:sca
   tth(i)=(nf(i)*nf(i+1)*sigma_z1(i));
end

return;



function nf=normf2d(sca);
th=1;

for i=0:sca-1
  tg=conv(th,getg(i));
  nf(i+1)=norm(tg)*norm(th);
  th=conv(th,geth(i));
end



function rima=iwt2d(wwr,wwc,ss,m)

%rima-----reconstructed image

[J,n,nn]=size(wwr);
```

```
j=J;
while j>0
   twwr=reshape(wwr(j,:,:),n,n);
   twwr=conv2(twwr,getk(j-1));
   twwr=twwr(:,128:128+n-1);
   twwr=conv2(twwr,getl(j-1)');
   twwr=twwr(128:128+n-1,:);

   twwc=reshape(wwc(j,:,:),n,n);
   twwc=conv2(twwc,getl(j-1));
   twwc=twwc(:,128:128+n-1);
   twwc=conv2(twwc,getk(j-1)');
   twwc=twwc(128:128+n-1,:);

   ss=conv2(ss,getnh(j-1));
   ss=ss(:,128:128+n-1);
   ss=conv2(ss,getnh(j-1)');
   ss=ss(128:128+n-1,:)+twwr+twwc;

   j=j-1;

end

rima=ss(m+1:n-m,m+1:n-m);
```

LAMPIRAN C
DATA MOS (MEAN OPINION SCORE)


STH 1
Citra Hasil Denoised
Responden A
Responden B
Responden C
Responden D
Responden E
Induk Wavelet
1 2 3 4 5 6
Haar
db4
Sym4
Bior6.8
STH 2
Induk Wavelet
Haar
db4
Sym4
Bior6.8
STH 3
Induk Wavelet
Haar
db4
Sym4
Bior6.8
STH 4
Induk Wavelet
Haar
db4
Sym4
Bior6.8


HTH 1
Induk Wavelet
Haar
db4
Sym4
Bior6.8
HTH 2
Induk Wavelet
Haar
db4
Sym4
Bior6.8
HTH 3
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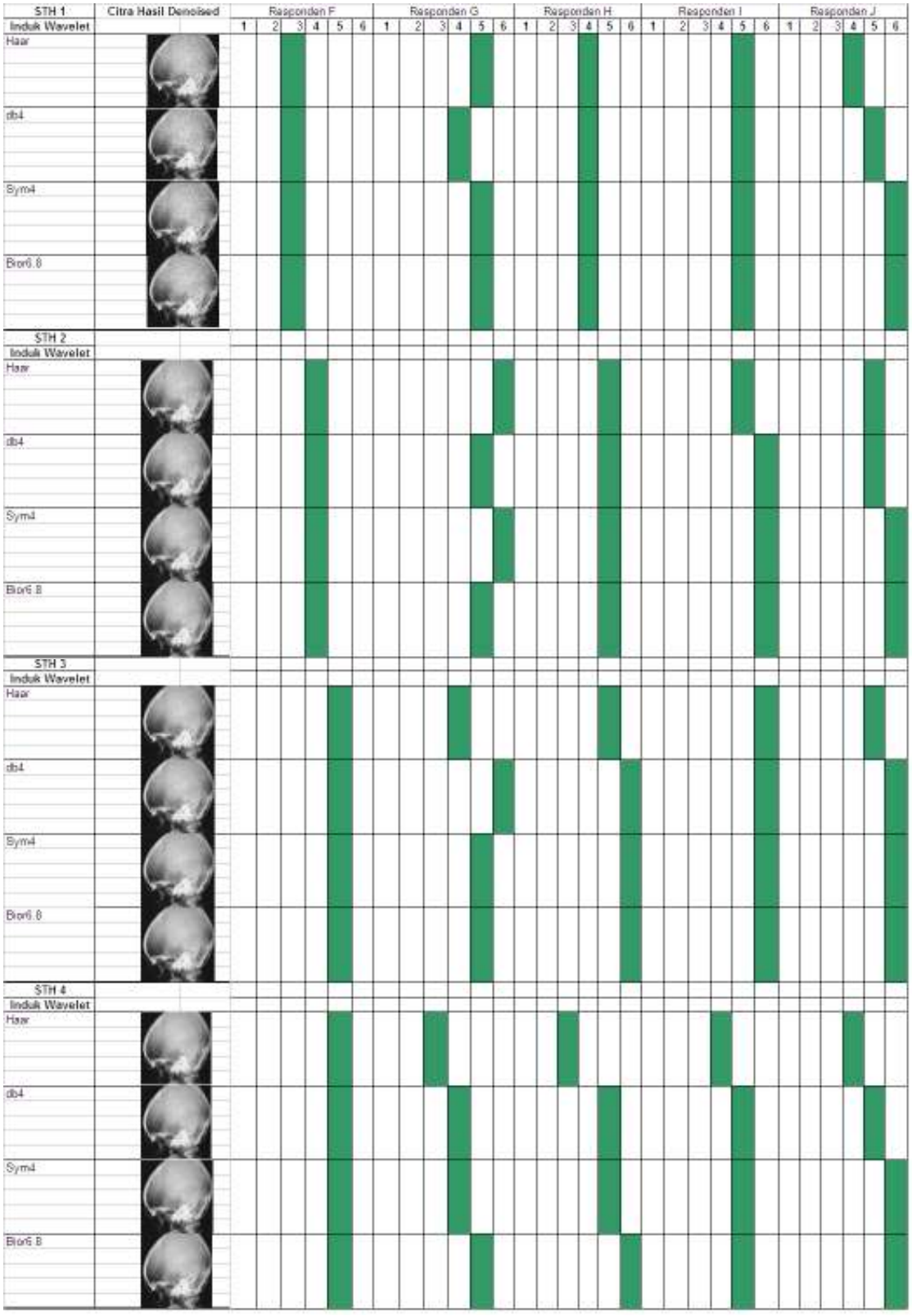
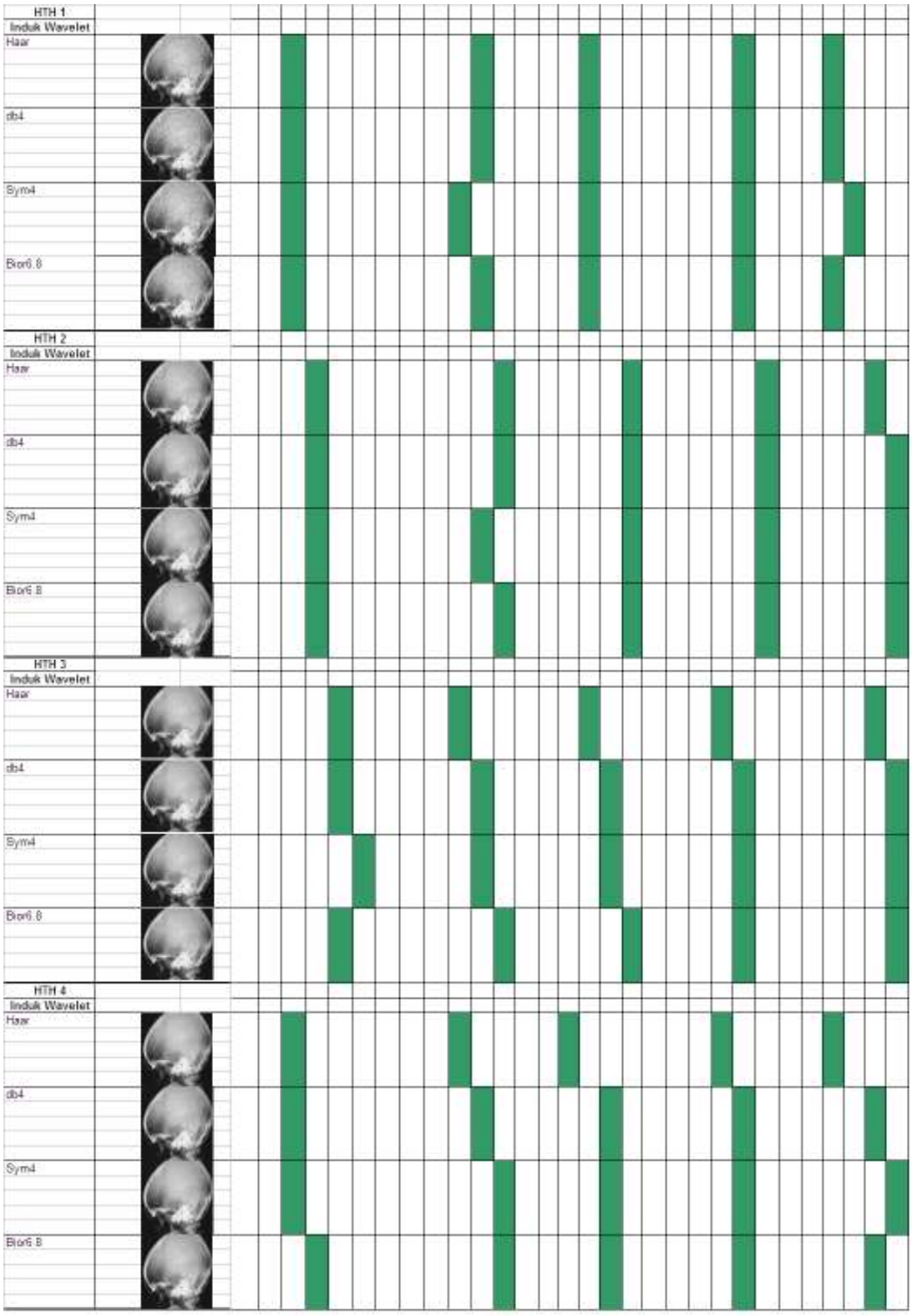
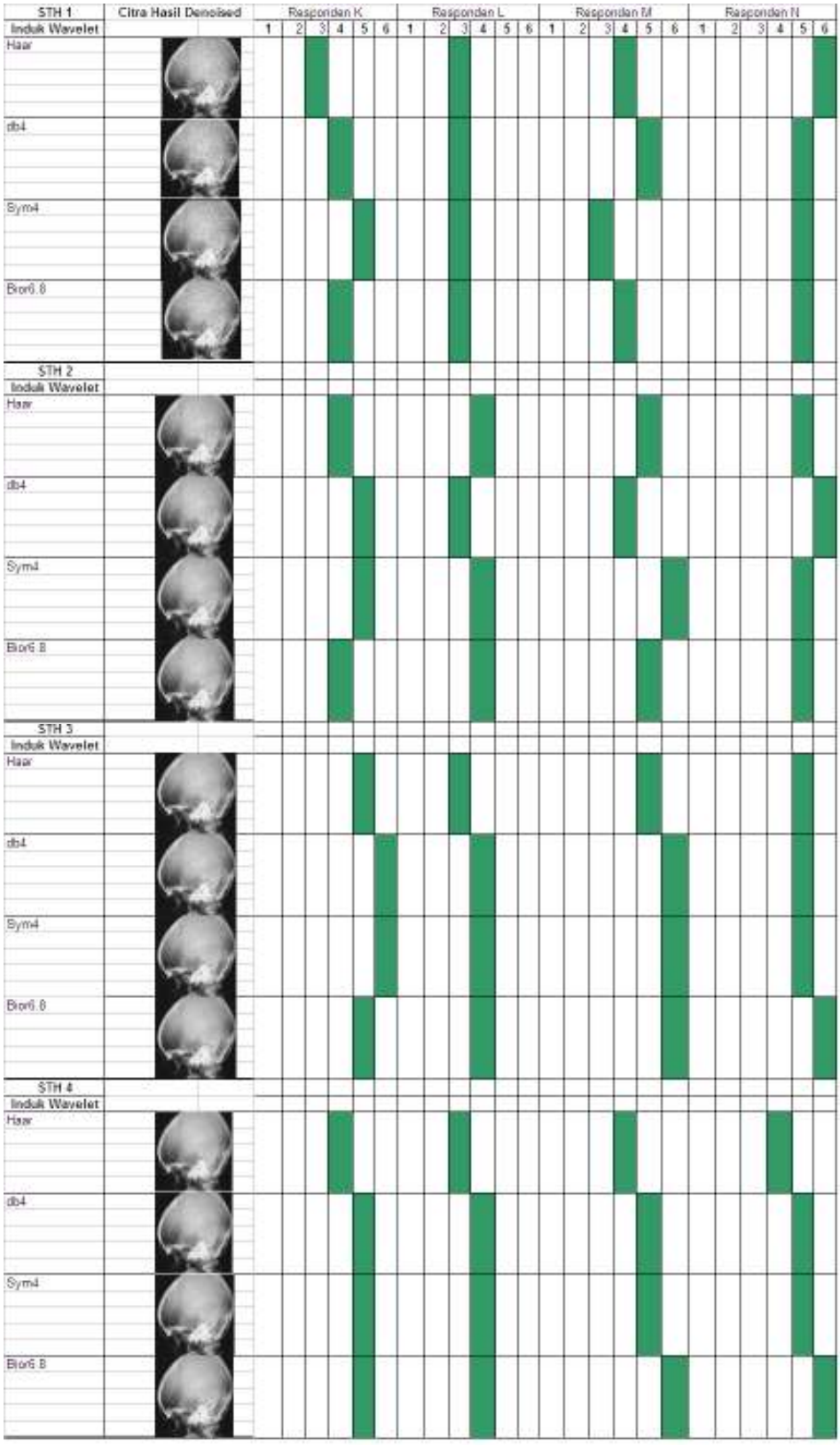
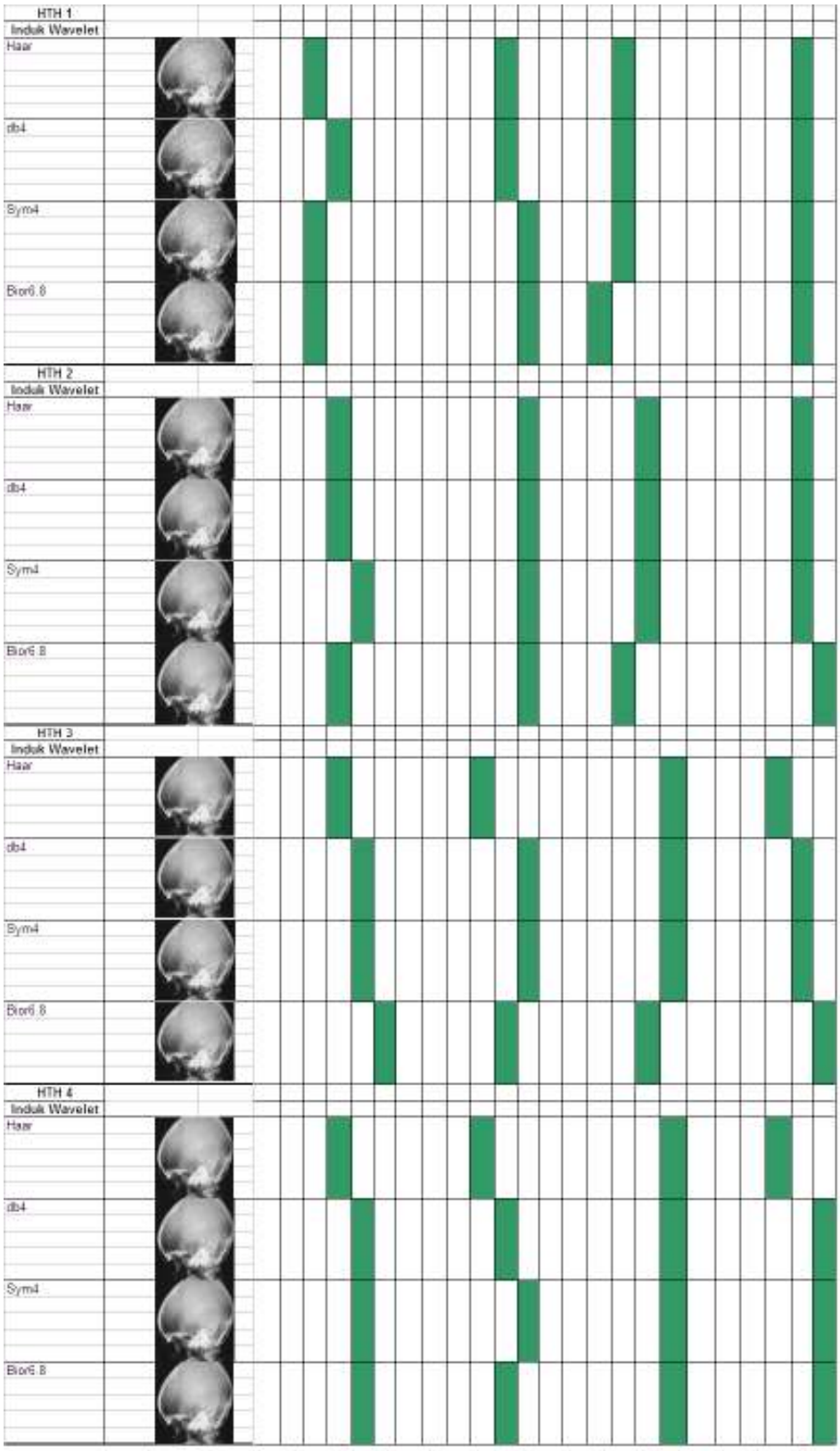
Haar
db4
Sym4
Bior6.8
HTH 4
Induk Wavelet
Haar
db4
Sym4
Bior6.8


STH 1
Citra Hasil Denoised
Responden F
Responden G
Responden H
Responden I
Responden J
Induk Wavelet
1 2 3 4 5 6
Haar
db4
Sym4
Bior6.8
STH 2
Induk Wavelet
Haar
db4
Sym4
Bior6.8
STH 3
Induk Wavelet
Haar
db4
Sym4
Bior6.8
STH 4
Induk Wavelet
Haar
db4
Sym4
Bior6.8


HTH 1
Induk Wavelet
Haar
db4
Sym4
Bior6.8
HTH 2
Induk Wavelet
Haar
db4
Sym4
Bior6.8
HTH 3
Induk Wavelet
Haar
db4
Sym4
Bior6.8
HTH 4
Induk Wavelet
Haar
db4
Sym4
Bior6.8


STH 1
Citra Hasil Denoised
Responden K
Responden L
Responden M
Responden N
Induk Wavelet
1 2 3 4 5 6
Haar
db4
Sym4
Bior6.8
STH 2
Induk Wavelet
Haar
db4
Sym4
Bior6.8
STH 3
Induk Wavelet
Haar
db4
Sym4
Bior6.8
STH 4
Induk Wavelet
Haar
db4
Sym4
Bior6.8


HTH 1
Induk Wavelet
Haar
db4
Sym4
Bior6.8
HTH 2
Induk Wavelet
Haar
db4
Sym4
Bior6.8
HTH 3
Induk Wavelet
Haar
db4
Sym4
Bior6.8
HTH 4
Induk Wavelet
Haar
db4
Sym4
Bior6.8