LAMPIRAN A

PROGRAM M-FILE PADA MATLAB 7.0.4

Program Utama

```
%Note:
%1. Need Matlab Wavelet Toolbox to run the code.
%2. In this code, the input image is a nxn square matrix

clear;
ima=imread('lena.tif','tif');
n=length(ima);%% ima is a nxn square image
ima=double(ima);
[mf,nf]=size(ima);
figure(1);clf;
imshow(ima,[0 255]);                    %% image original

v=25;
noi=v*randn(n,n);
iman=ima+noi;
figure(2);clf;
imshow(iman,[0 255]);                    %% noise image

pima=mean(mean(ima.^2));
MSEo=sum(sum((iman-ima).^2))/(mf*nf)       %% MSE Awal
PSNRO=10*log10(255*255/MSEo)                %% PSNR Awal

[ld,hd,lr,hr]=wfilters('bior1.3');
wbase=2;
%%%%wbase:
%1-bior1.1; 2-bior1.3; 3-bior2.2; 4-bior2.4
%5-bior3.3; 6-db2; 7-db3; 8-db4

J=3;
[S,HW,WH,WW,etl] = ocwt2d(iman,ld,hd,J);   %% transformasi overcomplete wavelet
%%%%%%%%denoising%%%%%%%%%%
s=[4 6 8 10];
rWW=dens(WW,v,wbase,1,s);
rWH=dens(WH,v,wbase,2,s);
rHW=dens(HW,v,wbase,3,s);
rima=iocwt2d(S,rHW,rWH,rWW,etl,lr,hr);        %% invers transformasi overcomplete
wavelet
err=ima-rima;
perr=mean(mean(err.^2));

snrss=10*log10(pima/perr)
figure(3);clf;
imshow(rima,[0 255]);                    %% denoise image

MSEs=sum(sum((rima-ima).^2))/(mf*nf)          %% MSE Akhir
PSNR=10*log10(255*255/MSEs)                 %% PSNR Akhir
```

Program Transformasi Overcomplete Wavelet

```
function [S,HW,WH,WW,etl] = ocwt2d(ima,ld,hd,J)
n=length(ima);
if n<128
   etl=n;
else
   etl=128;
end
m=etl;
ima=[ima(:,m:-1:1) ima ima(:,n:-1:n-m+1)];
ima=[ima(m:-1:1,:);ima;ima(n:-1:n-m+1,:)];

S=ima;
for j=1:J
   hf=padf0(ld,j);
   gf=padf0(hd,j);

   GS=conv2(S,gf);
   HS=conv2(S,hf);

   WH{j}=conv(GS,hf');
   WW{j}=conv(GS,gf');
   HW{j}=conv(HS,gf');
   S=conv2(HS,hf');

   clear GS HS;
end
```

Program Denoising

```
function rw=denss(W,v,wbase,flag,s)

%%%%wbase:
%1-bior1.1; 2-bior1.3; 3-bior2.2; 4-bior2.4
%5-bior3.3; 6-db2; 7-db3; 8-db4

s=2*s+1;
J=length(W);%% J should be less than 3

if wbase==1 %bior1.1
   ix=[1 2 4];iy=[1 2 4];
elseif wbase==2  %bior1.3
   ix=[5 10 20];iy=[5 10 20];
elseif wbase==3  %bior2.2
   if flag==1; ix=[5 10 20];iy=[5 10 20];
   elseif flag==2;ix=[6 12 24];iy=[5 10 20];
   else ix=[5 10 20];iy=[6 12 24];
   end
elseif wbase==4  %bior2.4
   if flag==1; ix=[9 18 36];iy=[9 18 36];
   elseif flag==2;ix=[10 20 40];iy=[9 18 36];
```

```
  else iy=[10 20 40];ix=[9 18 36];
  end
elseif wbase==5  %bior3.3
  ix=[7 14 28];iy=[7 14 28];
elseif wbase==6  %db2
  if flag==1; ix=[3 6 12];iy=[3 6 12];
  elseif flag==2; ix=[4 9 17];iy=[3 6 12];
  else iy=[4 9 17];ix=[3 6 12];
  end
elseif wbase==7  %db3
  if flag==1; ix=[3 6 12];iy=[3 6 12];
  elseif flag==2; ix=[8 16 31];iy=[5 10 21];
  else iy=[8 16 31];ix=[5 10 21];
  end
else %%%db4
  if flag==1; ix=[5 10 20];iy=[5 10 20];
  elseif flag==2;ix=[11 23 46];iy=[7 14 29];
  else iy=[11 23 46];ix=[7 14 29];
  end
end

 [th,r]=th_r(wbase,flag);
for z=1:J-1
  %%%%%%%%compute R%%%%%%
  R=[th(z)^2 r(z)*th(z)*th(z+1);r(z)*th(z)*th(z+1) th(z+1)^2]*v^2;
    w1=W{z};w2=W{z+1};
  n=length(w1);
  w2=w2(ix(z)+1:n+ix(z),iy(z)+1:n+iy(z));
    m=s(z);
  mm=m-mod(n,m);
  w1=[w1 w1(:,n:-1:n-mm+1)];w1=[w1;w1(n:-1:n-mm+1,:)];
  w2=[w2 w2(:,n:-1:n-mm+1)];w2=[w2;w2(n:-1:n-mm+1,:)];
  nn=(n+mm)/m;
  for ixx=1:nn
    for iyy=1:nn
      wd1=w1((ixx-1)*m+1:ixx*m,(iyy-1)*m+1:iyy*m);
      wd2=w2((ixx-1)*m+1:ixx*m,(iyy-1)*m+1:iyy*m);

      pwd1=sum(sum(wd1.^2))/m^2-R(1,1);pwd1=max(0,pwd1);
      pwd2=sum(sum(wd2.^2))/m^2-R(2,2);pwd2=max(0,pwd2);
      pwd12=sum(sum(wd1.*wd2))/m^2-R(1,2);pwd12=max(0,pwd12);

      P=[pwd1 pwd12;pwd12 pwd2];
      C=P*inv(P+R);

      wd1=wd1.*(abs(wd1)>2.5*sqrt(R(1,1)));
      wd2=wd2.*(abs(wd2)>2.5*sqrt(R(2,2)));
      for i=1:m
        for j=1:m
          Z=[wd1(i,j) wd2(i,j)]';
          cz=C*Z;
          wd1(i,j)=cz(1);
        end
```

```
      end

      rw1((ixx-1)*m+1:ixx*m,(iyy-1)*m+1:iyy*m)=wd1;
    end
  end

  rw1=rw1(1:n,1:n);
  rw{z}=rw1;
end

wJ=W{J};v=th(J)*v;
wJ=wJ.*(abs(wJ)>3.*v);
rw{J}=wJ;
```

Program Invers Transformasi Overcomplete Wavelet

```
function ima=iocwt2d(S,HW,WH,WW,etl,lr,hr)

J=length(WW);

for j=J:-1:1
  hf=padf (lr,j);
  gf=padf (hr,j);
  lf=length(hf)-1;

  GS=(conv2(WH{j},hf')+conv2(WW{j},gf'))/2;
  [nr,nc]=size(GS);
  GS=GS(lf+1:nr-lf,:);

  HS=(conv2(S,hf')+conv2(HW{j},gf'))/2;
  HS=HS(lf+1:nr-lf,:);

  S=(conv2(HS,hf)+conv2(GS,gf))/2;
  [nr,nc]=size(S);
  S=S(:,lf+1:nc-lf);
  clear HS GS;
end
[nr,nc]=size(S);
ima=S(etl+1:nr-etl,etl+1:nc-etl);
```

Program Threshold With LMMSE

```
if wbase==1 %bior1.1
  [ld,hd,lr,hr]=wfilters('bior1.1');
  [thw,twh,tww]=ct(ld,hd,J);
  if flag==1;
    th=tww;
    r=[0.5 0.5 0.5];
  else
    th=twh;
    r=[0.5 0.5 0.5];
  end
```

```
elseif wbase==2  %bior1.3
  [ld,hd,lr,hr]=wfilters('bior1.3');
  [thw,twh,tww]=ct(ld,hd,J);
  if flag==1;
    th=tww;
    r=[0.37 0.37 0.37];
  else
    th=twh;
    r=[0.49 0.49 0.49];
  end
elseif wbase==3  %bior2.2
  [ld,hd,lr,hr]=wfilters('bior2.2');
  [thw,twh,tww]=ct(ld,hd,J);
  if flag==1;
    th=tww;
    r=[0.28 0.25 0.23];
  else
    th=twh;
    r=[0.45 0.41 0.40];
  end
elseif wbase==4  %bior2.4
  [ld,hd,lr,hr]=wfilter('bior2.4');
  [thw,twh,tww]=ct(ld,hd,J);
  if flag==1;
    th=tww;
    r=[0.22 0.18 0.17];
  else
    th=twh;
    r=[0.37 0.32 0.30];
  end
elseif wbase==5  %bior3.3
  [ld,hd,lr,hr]=wfilters('bior3.3');
  [thw,twh,tww]=ct(ld,hd,J);
  if flag==1;
    th=tww;
    r=[0.16 0.12 0.11];
  else
    th=twh;
    r=[0.24 0.13 0.08];
  end
elseif wbase==6  %db2
  [ld,hd,lr,hr]=wfilter('db2');
  [thw,twh,tww]=ct(ld,hd,J);
  if flag==1;
    th=tww;
    r=[0.33 0.33 0.33];
  else
    th=twh;
    r=[0.48 0.48 0.48];
  end
elseif wbase==7  %db3
  [ld,hd,lr,hr]=wfilters('db3');
  [thw,twh,tww]=ct(ld,hd,J);
```

```
  if flag==1;
    th=tww;
    r=[0.23 0.23 0.23];
  else
    th=twh;
    r=[0.38 0.38 0.33];
  end
else %%%db4
  [ld,hd,lr,hr]=wfilters('db4');
  [thw,twh,tww]=ct(ld,hd,J);
  if flag==1;
    th=tww;
    r=[0.22 0.22 0.22];
  else
    th=twh;
    r=[0.28 0.28 0.25];
  end
end

function [thw,twh,tww]=ct(ld,hd,J)

%%%compute the threshold%%%%%%%%%%
hx=1;
hy=1;
for j=1:J
  lf=padf0(ld,j);
  hf=padf0(hd,j);

  t_wwx=conv(hx,hf);
  t_wwy=conv(hy,hf);
  tww(j)=norm(t_wwx)*norm(t_wwy);
  t_whx=conv(hx,hf);
  t_why=conv(hy,lf);
  twh(j)=norm(t_whx)*norm(t_why);
  t_hwx=conv(hx,lf);
  t_hwy=conv(hy,hf);
  thw(j)=norm(t_hwx)*norm(t_hwy);
  hx=conv(hx,lf);
  hy=conv(hy,lf);
end
```

LAMPIRAN B

ANGKET MOS UNTUK 10 RESPONDEN

Gambar Lena

Induk Wavelet	Responden A						Responden B						Responden C						Responden D						Responden E						Responden F						Responden G						Responden H						Responden I						Responden J					
	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6
Bior 1.1					v						v							v						v					v						v						v						v						v					v	
Bior 1.3						v						v						v						v					v						v						v						v						v						v
Bior 2.2				v							v						v					v							v						v					v						v						v					v	
Bior 2.4						v				v						v								v				v						v					v					v						v					v					v	
Bior 3.3				v						v						v						v						v								v						v						v					v						v
db2					v						v						v						v						v						v						v						v						v					v	
db3					v						v						v					v							v						v					v						v						v					v	
db4				v						v							v					v						v							v						v						v						v						v

Gambar Cameraman

Induk Wavelet	Responden A						Responden B						Responden C						Responden D						Responden E						Responden F						Responden G						Responden H						Responden I						Responden J					
	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6
Bior 1.1				v						v							v						v					v						v						v						v						v					v	
Bior 1.3					v						v						v						v					v						v						v						v						v						v
Bior 2.2			v								v					v						v							v						v					v						v						v					v	
Bior 2.4					v					v						v							v					v						v				v						v						v					v					v	
Bior 3.3				v						v					v							v						v					v						v						v						v					v					
db2				v						v						v						v						v						v						v						v						v					v	
db3				v						v						v						v							v						v					v						v						v					v	
db4				v					v							v						v						v						v						v						v						v						v

Gambar Pepper

Induk Wavelet	Responden A						Responden B						Responden C						Responden D						Responden E						Responden F						Responden G						Responden H						Responden I						Responden J					
	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6
Bior 1.1						v					v						v							v					v							v					v							v					v							v
Bior 1.3						v						v						v						v					v							v						v						v						v						v
Bior 2.2				v						v							v					v							v					v							v					v							v						v	
Bior 2.4						v			v							v								v				v						v						v						v						v							v	
Bior 3.3				v					v									v				v					v								v							v				v					v							v		
db2				v							v						v						v						v						v						v						v						v					v		
db3					v						v					v						v							v						v					v							v						v						v	
db4				v						v							v					v						v								v					v					v						v								v

Gambar House

Induk Wavelet	Responden A						Responden B						Responden C						Responden D						Responden E						Responden F						Responden G						Responden H						Responden I						Responden J					
	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6
Bior 1.1						v					v							v						v					v							v						v					v							v					v	
Bior 1.3						v						v						v						v						v						v						v						v						v						v
Bior 2.2					v						v						v					v							v						v						v					v							v						v	
Bior 2.4						v				v							v							v				v							v						v					v						v							v	
Bior 3.3				v						v							v						v					v								v						v			v								v					v		
db2					v							v					v						v							v						v					v							v					v						v	
db3						v					v						v					v								v					v					v							v							v					v	
db4				v							v						v					v								v					v						v					v						v								v