DAFTAR PUSTAKA

[1] Bappenas, 2005. Pencegahan dan Penanggulangan Terorisme, www.bappenas.go.id/index.php?module=Filemanager, diakses 10 Januari 2008.

[2] .....,2005. Rising Robot, Discovery Chanel (Electronic Version)

[3] Pitowarno, Endra., 2006. Robotika : Desain, Kontrol dan Kecerdasan Buatan. Penerbit ANDI, Yogyakarta.

[4] Syahrony., Syahputra,Amsar., Desain Security Robot dengan Manipulator Empat Degree of Freedom. Skripsi Jurusan Mesin Universitas Hasanuddin.

[5] Erwiansah, Ahmad.,Sahril, Aulia.,2008. Desain dan Kontrol Prototipe Robot Fire Fighting Tipe Traching Wheels. Skripsi Jurusan Mesin Universitas Hasanuddin.

[6] Rosen, Jacob., 1989. Models of Robot Manipulation : Introduction & Basic Ideas – Speed Description & Transformation. Department of Electrical Engineering –University of Washintong.

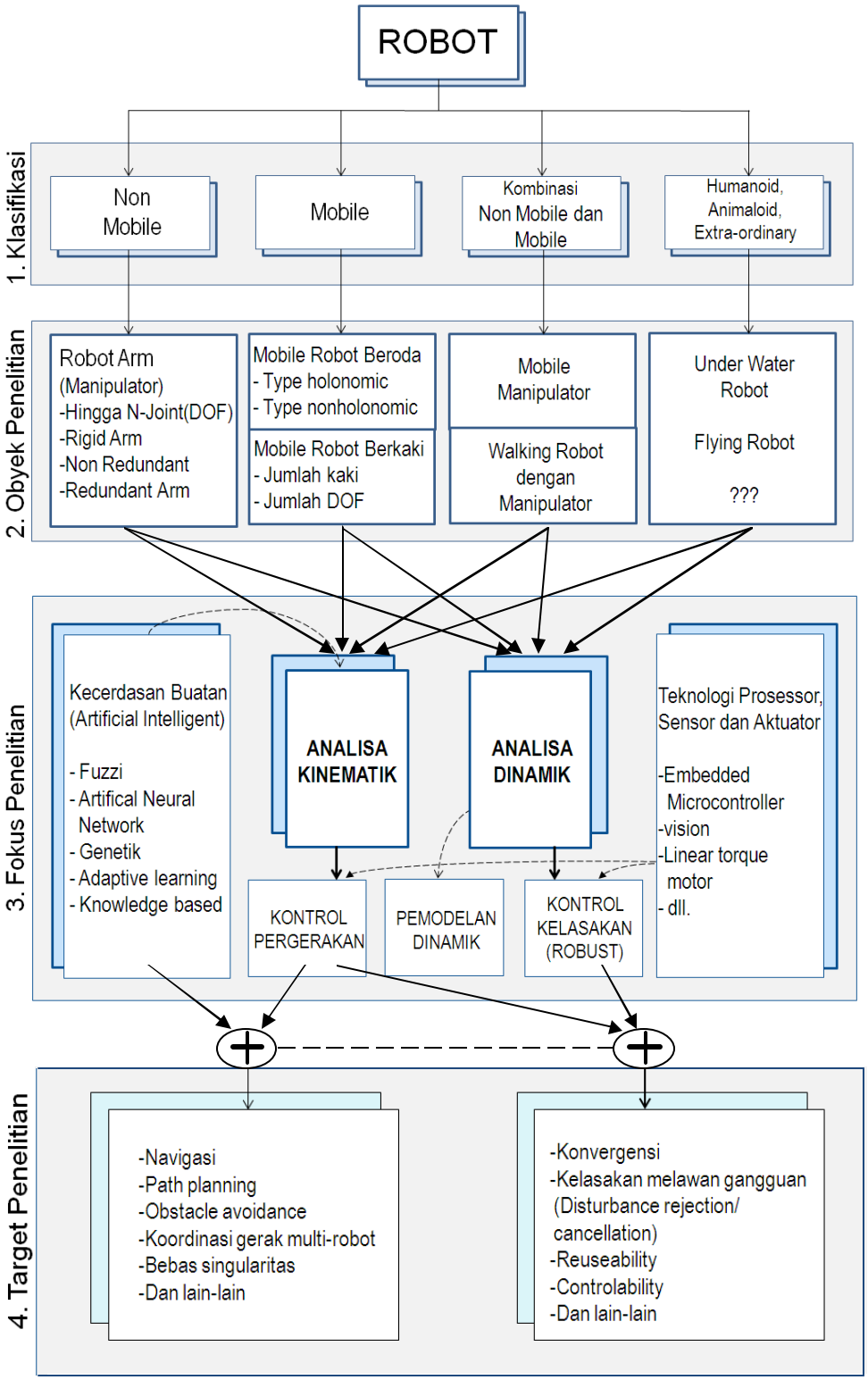
[7] ....., 1989. Models of Robot Manipulation : Jacobian. Department of Electrical Engineering –University of Washintong.

[8] ....., 1989. Models of Robot Manipulation : Direct manipulator Kinematics. Department of Electrical Engineering –University of Washintong.

[9] Groover, Mikell. P., Weiss, Mitchell., Nagel, Roger. N., Odrey, Nicholas. G., 1986. Industrial Robotics-Technology, Programming, and Applications. McGraw-Hill Book Company, New York.

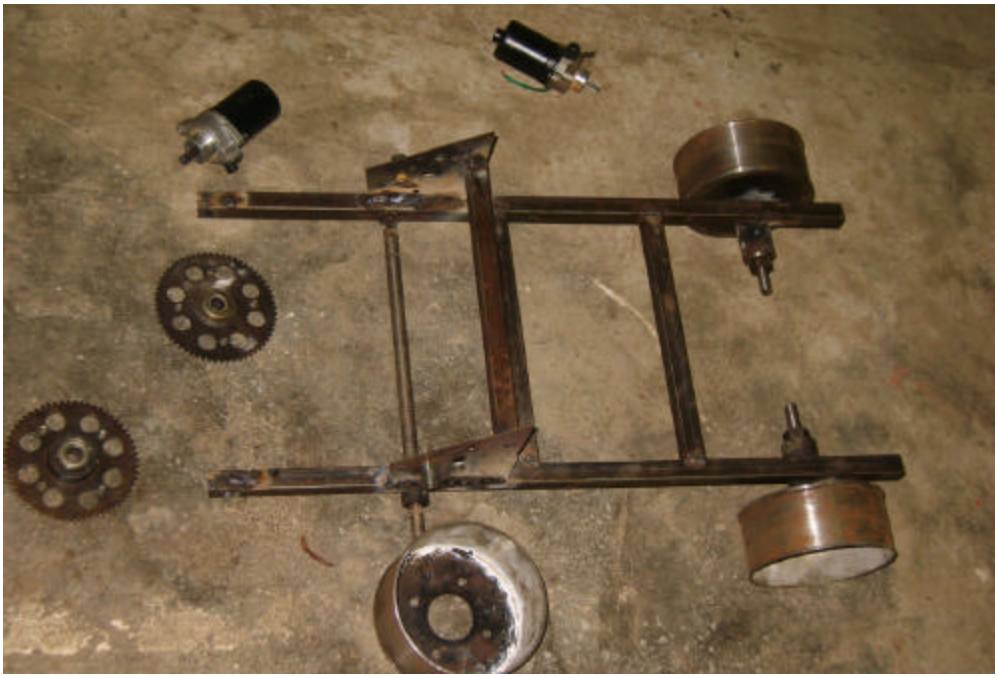
LAMPIRAN

LAMPIRAN I : ILUSTRASI PENELITIAN DALAM DOMAIN ROBOT



*) Sumber Endra pitowarno (2006)

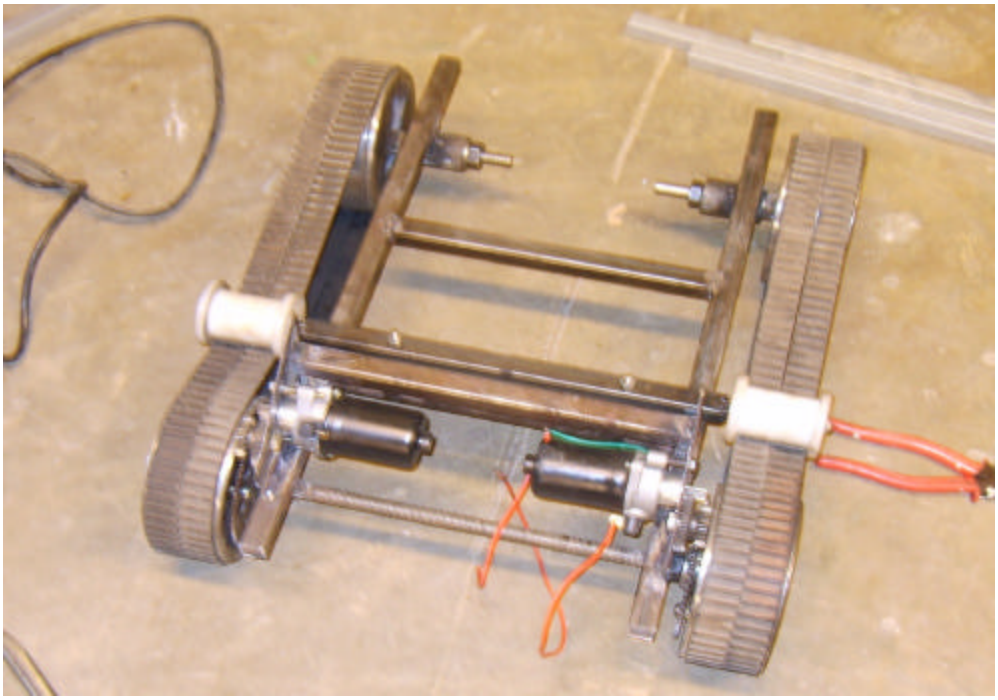
LAMPIRAN III : FOTO ROBOT



Proses Merangkai Robot Penjinak Bom

Gigi Transmisi, Actuator dan Baut Roda Robot Penjinak Bom

LAMPIRAN III : FOTO ROBOT *(Lanjutan)*

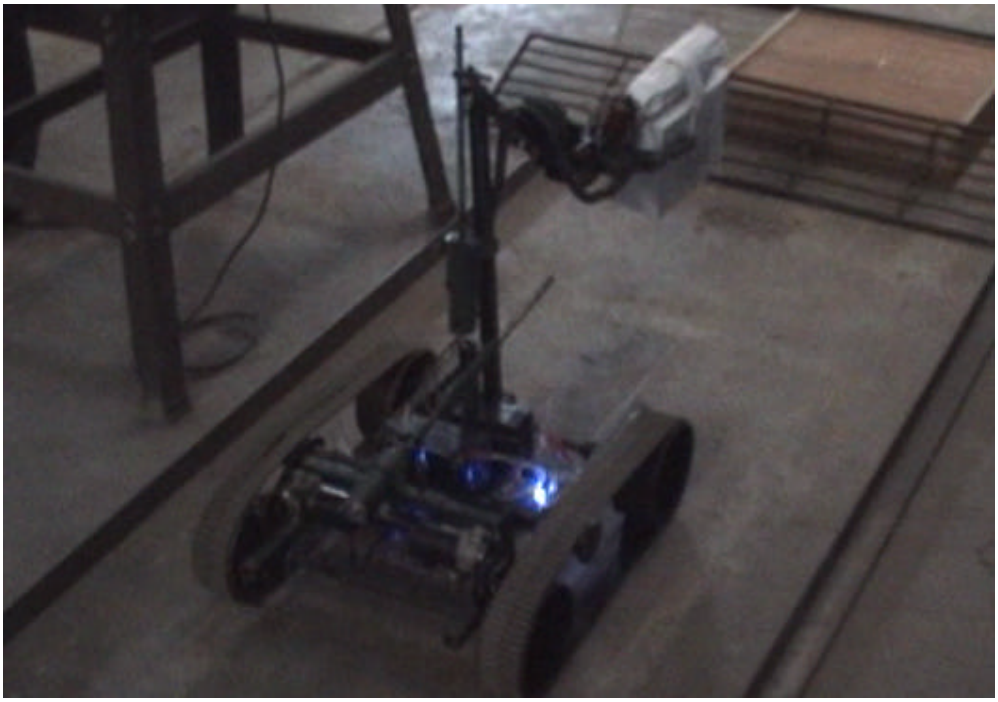


Struktur Mekanik Mobile Robot Penjinak Bom

Robot Prnjinak Bom setelah dirakit

LAMPIRAN III : FOTO ROBOT *(Lanjutan)*

Pengujian Robot Penjinak Bom di luar ruangan



Pengujian Robot Penjinak Bom di dalam ruangan

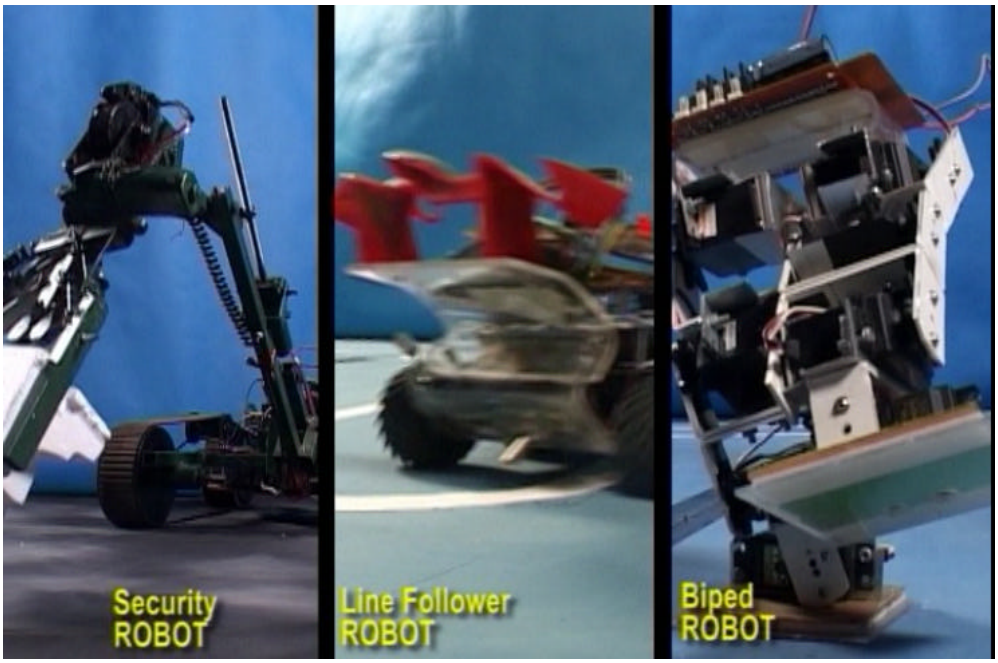
LAMPIRAN III : FOTO ROBOT *(Lanjutan)*

Kontrol Robot Penjinak Bom pada saat dilakukan uji lapangan

Robot Penjinak Bom diikut sertakan dalam Pameran Teknologi
di Kabupaten Bantaeng pada Agustus 2008

LAMPIRAN III : FOTO ROBOT *(Lanjutan)*

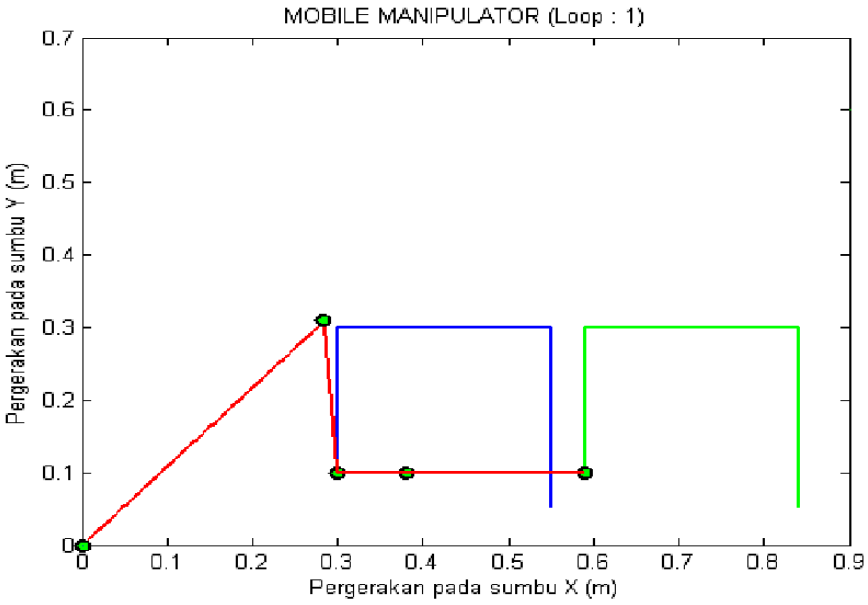
Robot Penjinak Bom diikut sertakan dalam Pameran Teknologi
di Kabupaten Bantaeng pada Agustus 2008



Robot Penjinak Bom di libatkan juga gambarnya dalam pembuatan Profil
Unhas yang dibuat oleh Community Laboratory FISIP Unhas 2008

LAMPIRAN IV: CONTOH PERHITUNGAN

Aplikasi perhitungan DH parameter untuk Kinematika Maju (*Forward Kinematic*) dapat kita lihat pada perhitungan-perhitungan parameter pada Manipulator 4 DOF.



Gambar Konfigurasi Manipulator Robot 4 DOF

Diketahui :

L1	= 0,42 m	?1	= 47,45^o
L2	= 0,21 m	?2	= 226,91^o
L3	= 0,08 m	?3	= 85,64^o
L4	= 0,20 m	?4	= 0^o

Permasalahan :

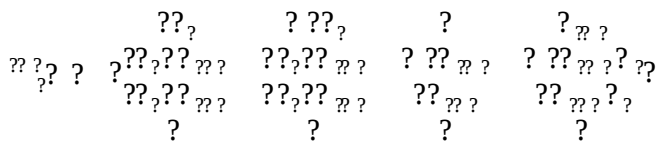
Tentukan posisi dari end effector dari konfigurasi manipulator robot 4 DOF diatas?

LAMPIRAN IV: CONTOH PERHITUNGAN *(Lanjutan)*

DH Parameter :

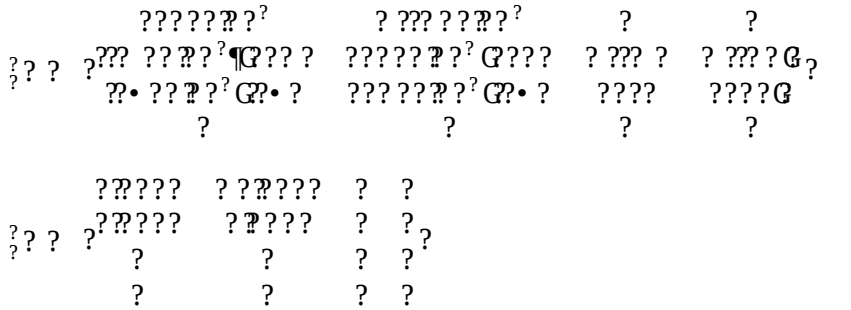
i-l	*i*	?	?	?	?
0	1	0	0	0	? 47,45
1	2	0	?	0	? ?
2	3	0	?	0	? ?
3	4	90	?	0	? ?

Rumus umum adalah :

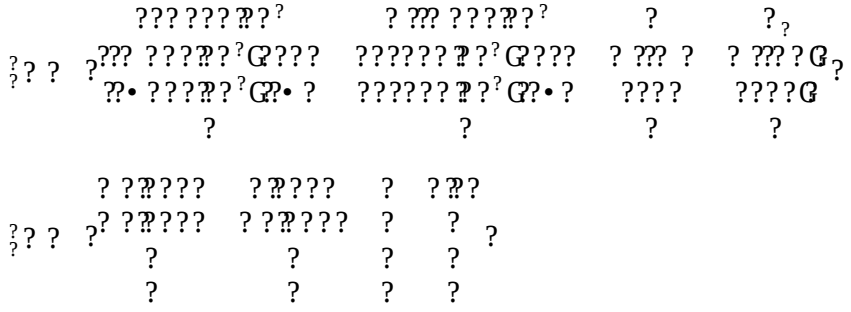


Berdasarkan Tabel DH Parameter maka transformasi matriks setiap sumbu adalah sebagai berikut :

1. Transformasi matriks untuk Sumbu 1 ? adalah :

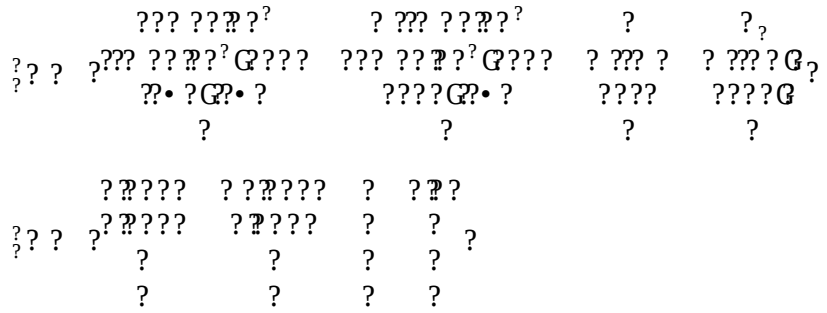


2. Transformasi matriks untuk Sumbu 2 ? adalah :

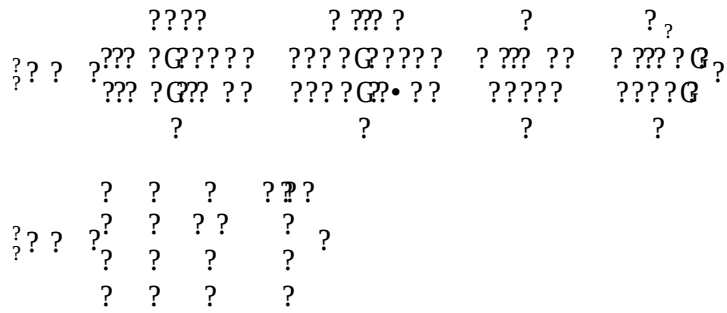


LAMPIRAN IV: CONTOH PERHITUNGAN *(Lanjutan)*

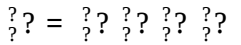
3. Transformasi matriks untuk Sumbu 3 adalah :



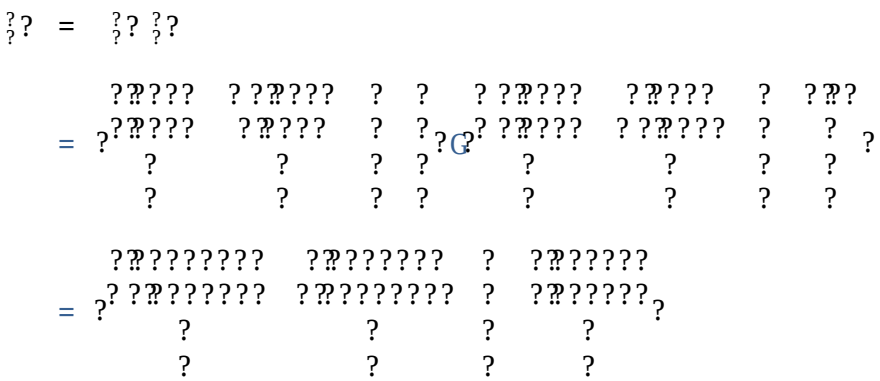
4. Transformasi matriks untuk Sumbu 4 adalah :



Jadi pergerakan lengan-lengan manipulator dari dasar (base) sampai sumbu 4 dapat kita lihat pada persamaan dibawah ini:



- *Pergerakan lengan dari dasar (base) menuju sumbu 2 yaitu :*



LAMPIRAN IV: CONTOH PERHITUNGAN *(Lanjutan)*

Jadi posisi x dan y dalam sumbu 2 adalah

*x*2 = ? ?????? *(m)*

*y*2 = ? ?????? *(m)*

- *Pergerakan lengan dari dasar (base) menuju sumbu 3 yaitu :*

??? = ???? ???

=

??????????? ?????????? ? ????????? ?????? ? ?????? ? ????
? ? ?????????? ?????????? ? ?????????? ? ?????? ?????? ? ? ?
? ? ? ? ? ? ? ?
? ? ? ? ? ? ? ?

?????? ? ?????? ? ????????
= ? ?????? ?????? ? ????????
? ? ? ?
? ? ? ?

Jadi posisi x dan y dalam sumbu 3 adalah

*x*3 = ? ??????????? *(m)*

*y*3 = ? ??????????? *(m)*

- *Pergerakan lengan dari dasar (base) menuju sumbu 4 yaitu :*

??? = ???? ???

?????? ? ?????? ? ???????? ? ? ? ????
= ? ?????? ?????? ? ????????? . ? ? ? ? ? ? ?
? ? ? ? ? ? ? ?
? ? ? ? ? ? ? ?

????????? ? ????????? ?????????
= ? ????????? ? ? ????????? ????????? ?
? ? ? ?
? ? ? ?

Jadi posisi x dan y dalam sumbu 4 adalah

*x*4 = ? ????????*(m)*

*y*4 = ? ????????*(m)*

LAMPIRAN IV: CONTOH PERHITUNGAN *(Lanjutan)*

- *Pergerakan lengan dari dasar (base) menuju end effector yaitu :*

Persamaannya :

= .

Jadi :

=

= 0,20. + 0,08.

+ 0,21

+ 0,42 .

= 0,5897 m

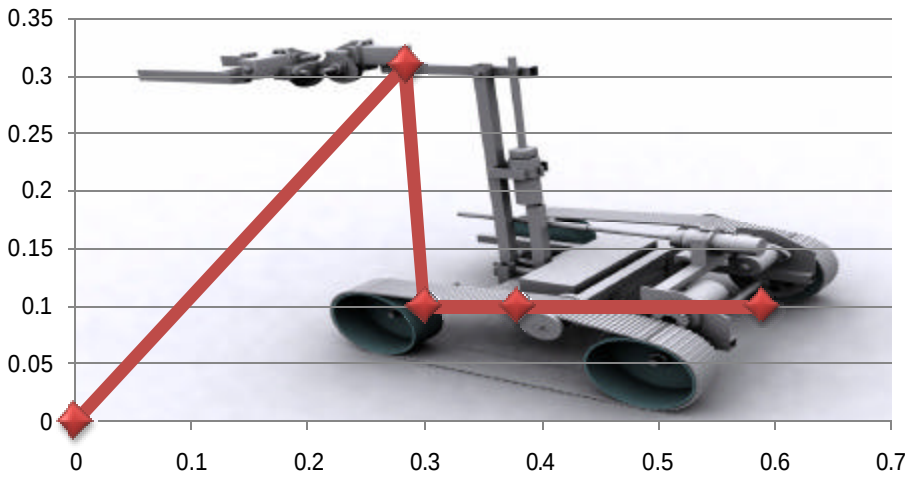
=

= 0,20. + 0,08.

+ 0,21

+ 0,42 .

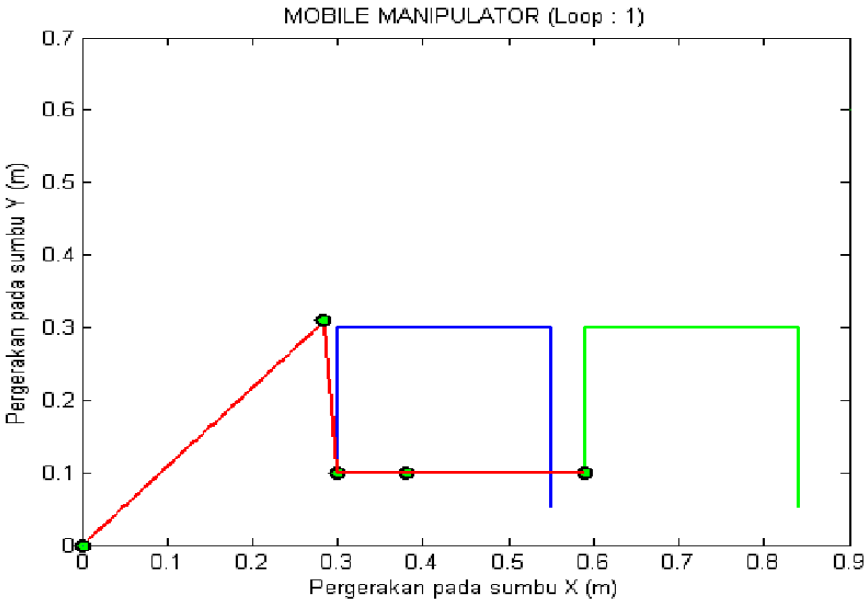
= 0,10002 m



Grafik Pergerakan Manipulator Robot dari dasar (base) sampai ujung end effector

LAMPIRAN V: CONTOH PERHITUNGAN

Aplikasi perhitungan DH parameter untuk Kinematika Mundur (*Inverse Kinematic*) dapat kita lihat pada perhitungan-perhitungan parameter pada Manipulator 4 DOF.



Gambar Konfigurasi Manipulator Robot 4 DOF
Yang digunakan pada Robot Penjinak Bom

Diketahui :

L1	=	0,42 m	x_T	=	0,5897 m
L2	=	0,21 m	y_T	=	0,10002 m
L3	=	0,08 m	x	=	m
L4	=	0,20 m	y	=	m

Permasalahan :

Karena , Tentukan ?

LAMPIRAN V: CONTOH PERHITUNGAN *(lanjutan)*

a. Menentukan Persamaan $?_?$

Rumus :

$$?_? = ??? ????\frac{?^{?}? ?^{?}? \; _?^{?}? \; _?^{?}?}{? \; _? \; _?}?$$

Dimana :

x = ??.????? m

y = ??.????? m

L1 = 0,42 m

L2 = 0,21 m

Jadi :

$$?_? = ??? ????\frac{??.????? \; _?^{?}? \; _?.????? \; _?^{?}???.^{?}??.^{?}}{?_?.??.?_?.???}?$$

$?_? = 227^{o}$

b. Menentukan Persamaan $?_?$

$$?_? = ??? ???\frac{?}{?}? \; ??? ???\frac{?_?}{?}$$

Dimana :

x = ??.????? m

$?_? = ?_?? \; ?_?._?$

= ??.??? ??.??G?????^?

$?_? = ?_?._?$

= ??.??G?.• ???^?

r = $\sqrt{??.???? \; ??.??G?????^?.?^? \; ??.??G?.• ???^?.?^?}$

Jadi :

$?_? = 47{,}45^{o}$

LAMPIRAN V: CONTOH PERHITUNGAN *(lanjutan)*

c. Menentukan Persamaan ?? :

Rumus :

?? = I ? ?? ? ??

Dimana :

?? = $47{,}45^{o}$

?? = 227^{o}

?? = ? ????? ? ? ????? ? ? ???? ? ? ???

= (? ? ? ?? ??? ?? ? ? ???? ? ? ???

= ??? ? ?? ???? ??? ? ?? ? ??? ? ?? ??? ??? ? ??? ? ?? ??? ??

= ?? ? ? ? ?????I ? ?? ??? ?? ? ? ??? ? ?? ??? ??

I = *arc cos* (? ? ? ? ???? ??? ? ? ? ?? ? ? ?? ??? ??) / (?? ? ??)

= *arc cos* (? ?? ? ? ? ? ??? ? ? ?????? ? ? ? ? ??? ? ? ? ? ??? ? ? ? ? ? ?) / (? ? ?? ? ? ? ? ?)

= *$360{,}09^{o}$*

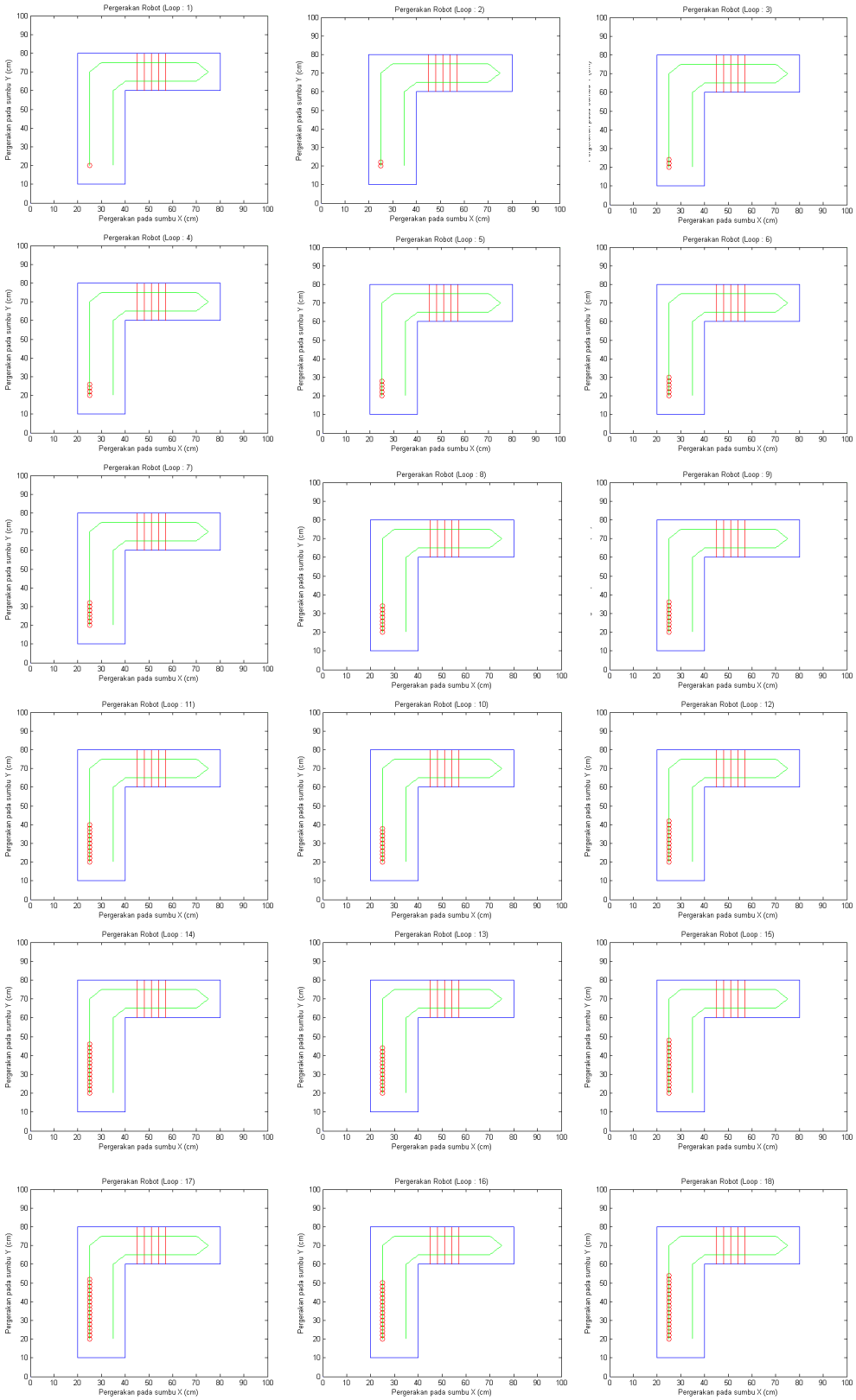
Jadi:

?? = I ? ?? ? ??

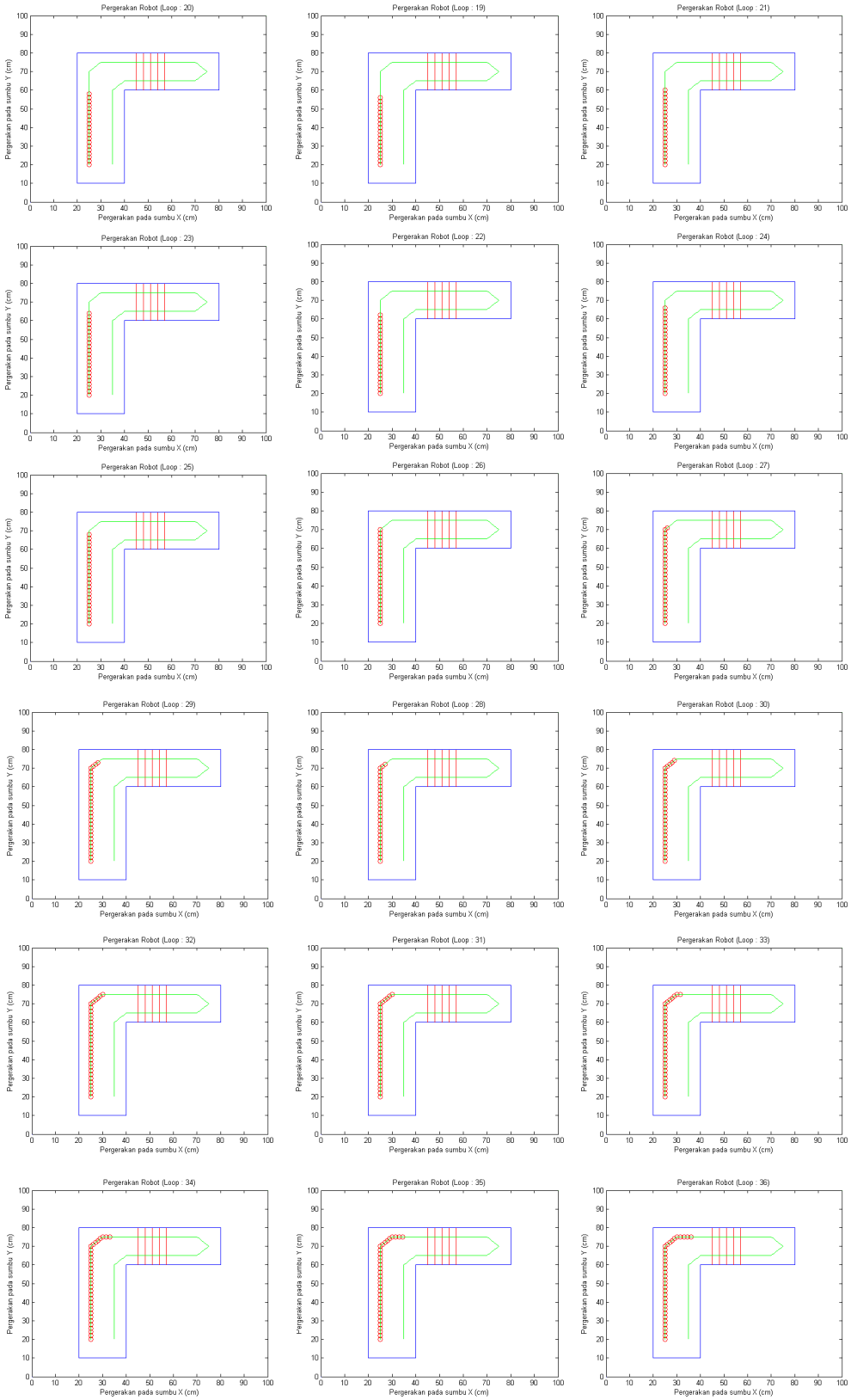
= ?????? ? ? ???? ? ? ???

= $85{,}64^{o}$

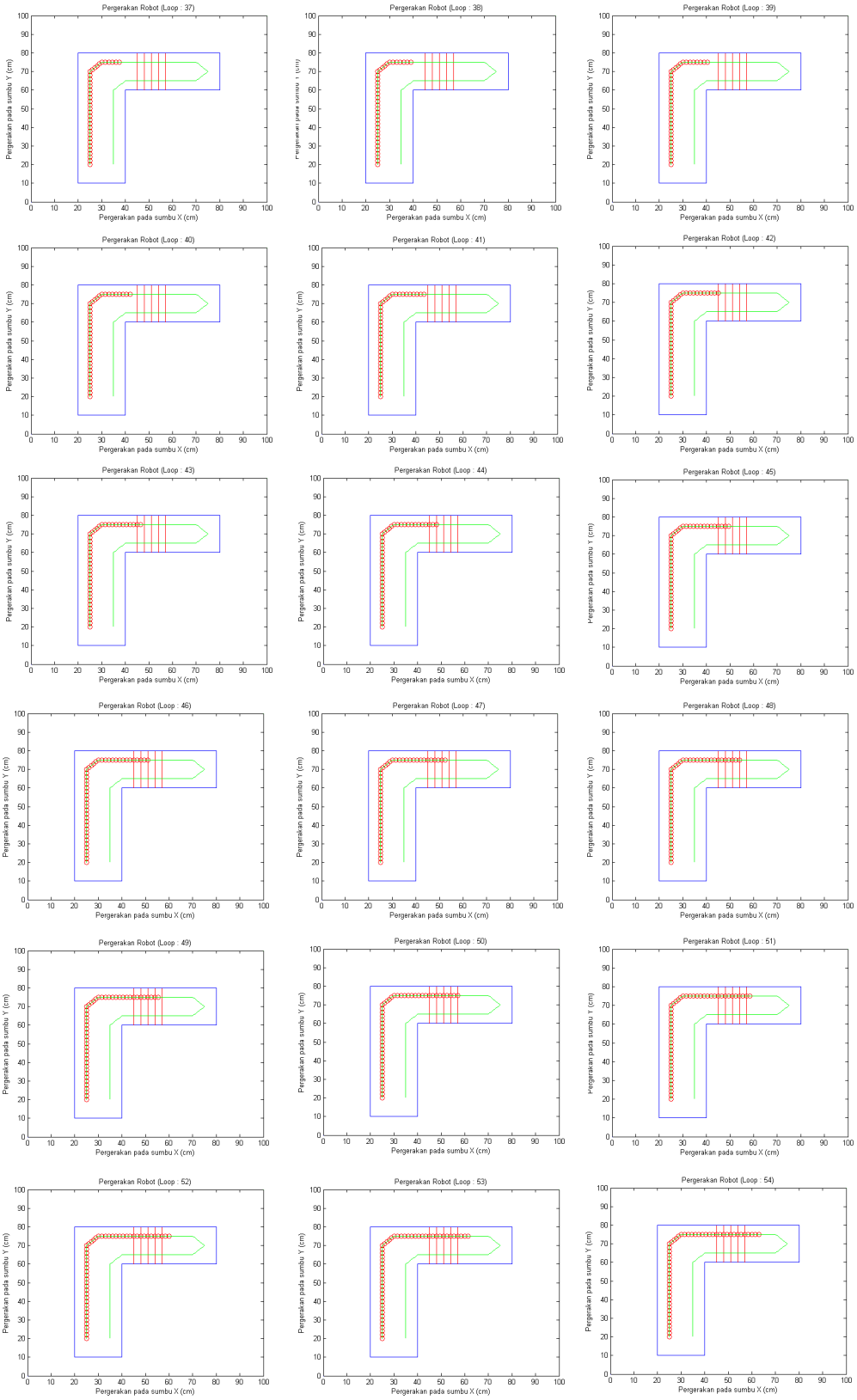
LAMPIRAN VII : PERGERAKAN MOBILE ROBOT HASIL SIMULASI



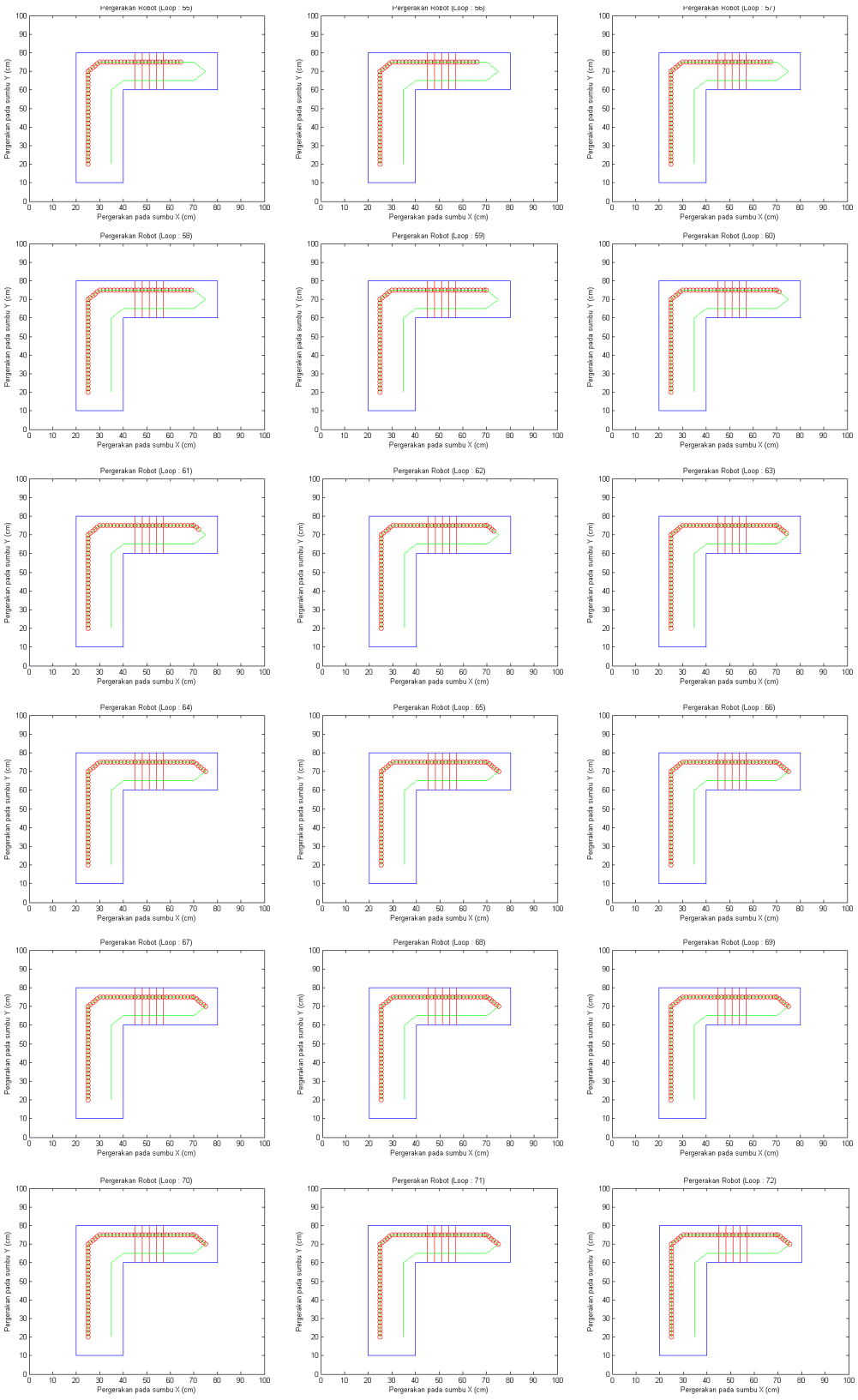
PERGERAKAN MOBILE ROBOT HASIL SIMULASI *(Lanjutan)*



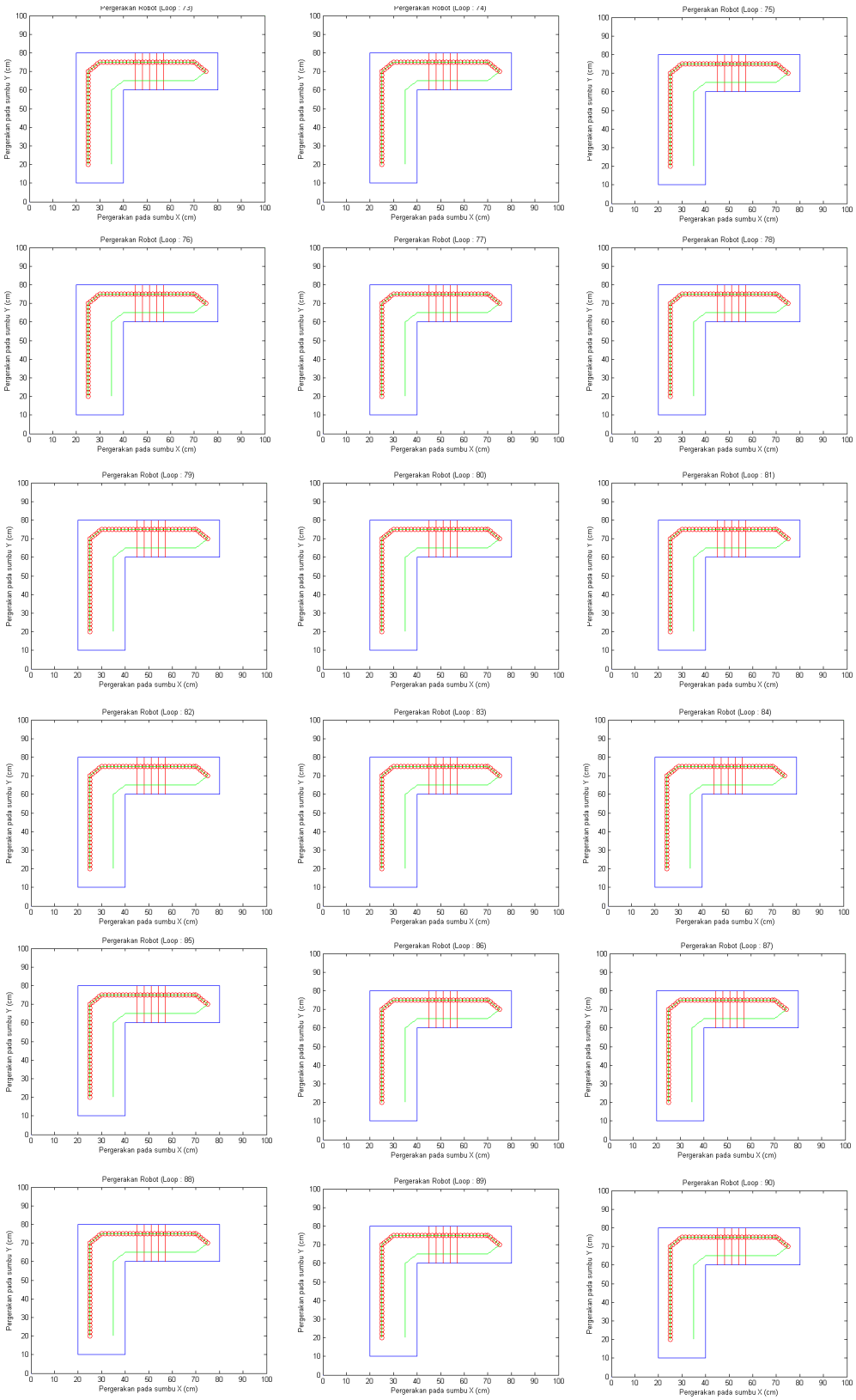
PERGERAKAN MOBILE ROBOT HASIL SIMULASI *(Lanjutan)*



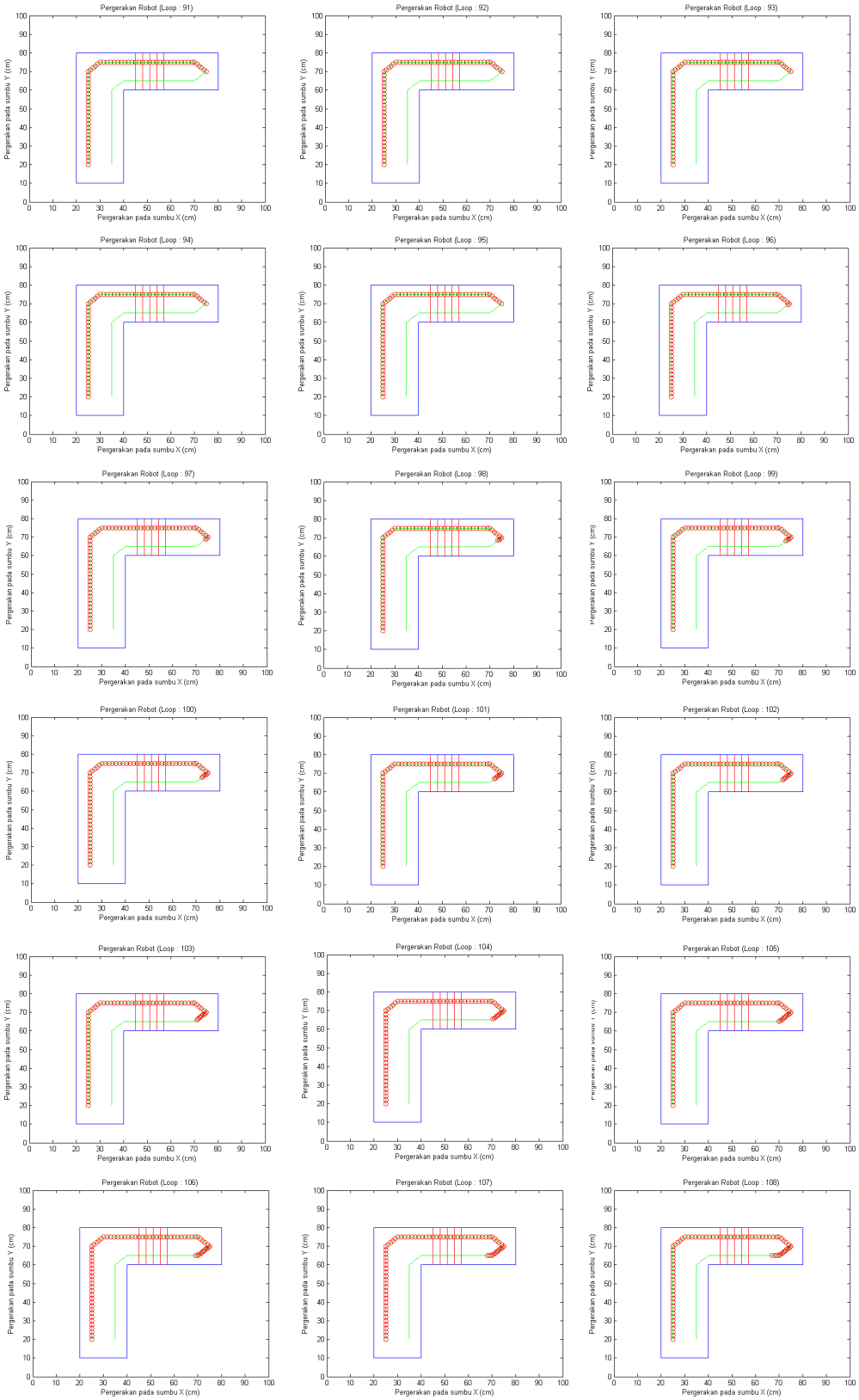
PERGERAKAN MOBILE ROBOT HASIL SIMULASI *(Lanjutan)*



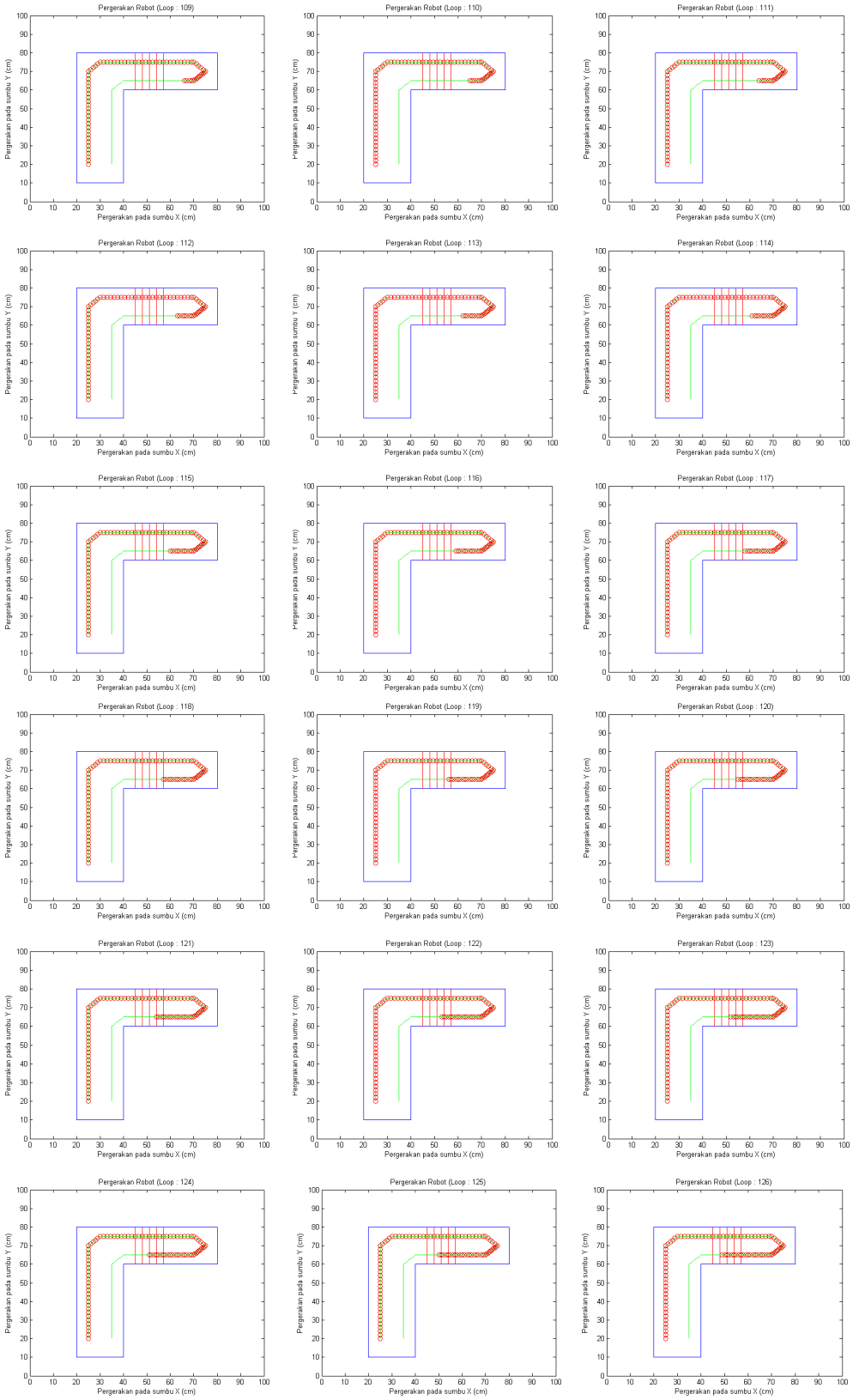
PERGERAKAN MOBILE ROBOT HASIL SIMULASI *(Lanjutan)*



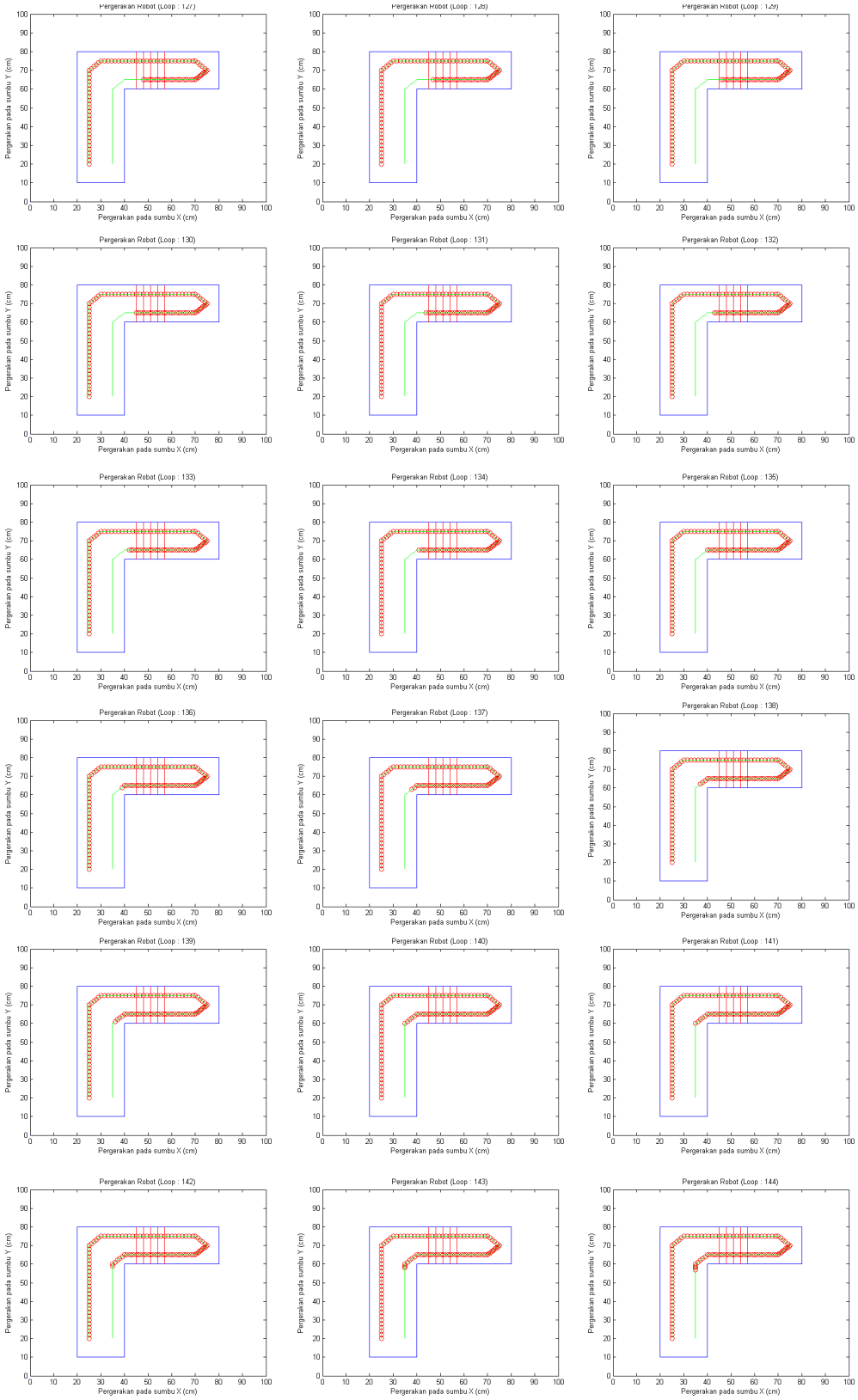
PERGERAKAN MOBILE ROBOT HASIL SIMULASI *(Lanjutan)*



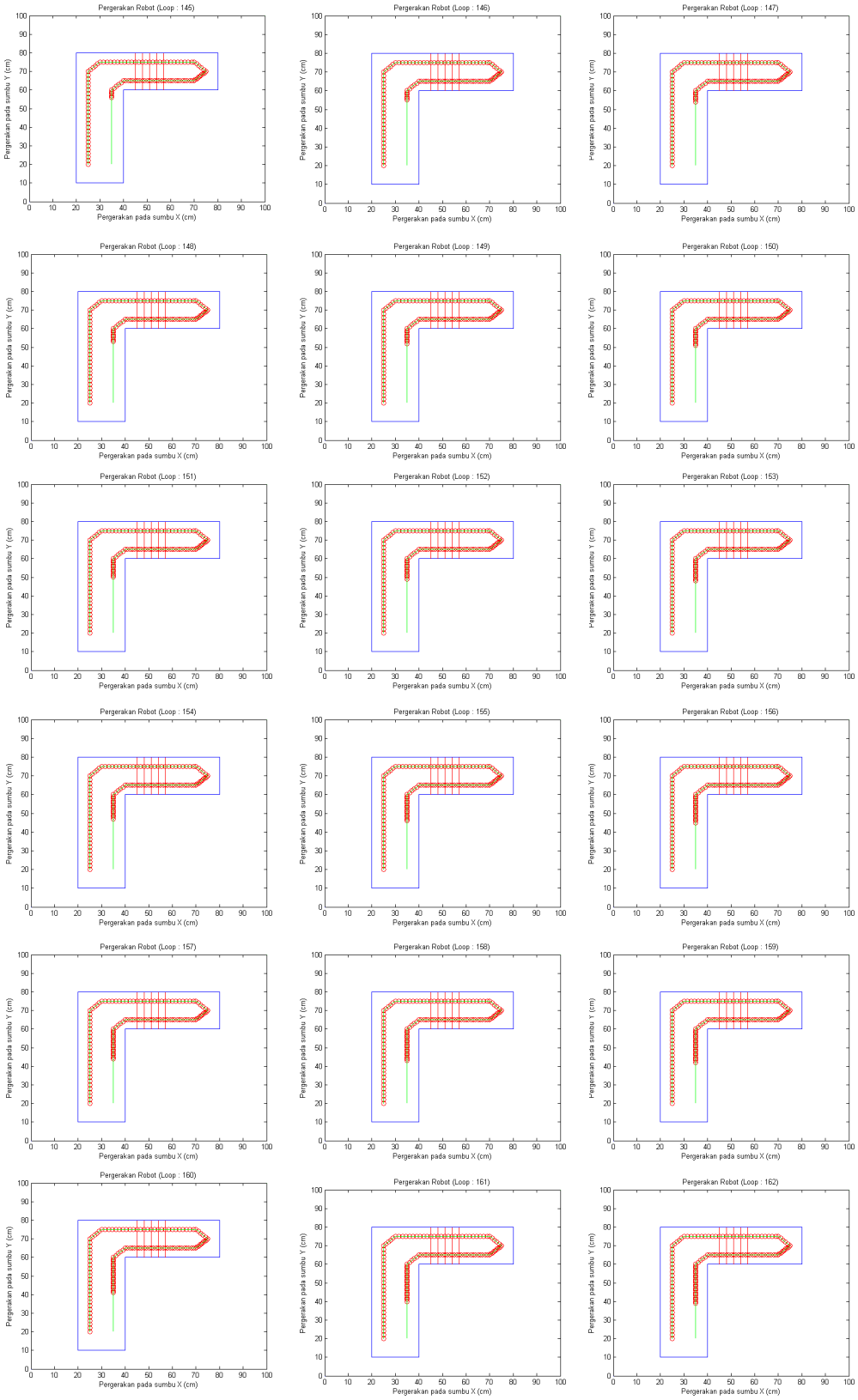
PERGERAKAN MOBILE ROBOT HASIL SIMULASI *(Lanjutan)*



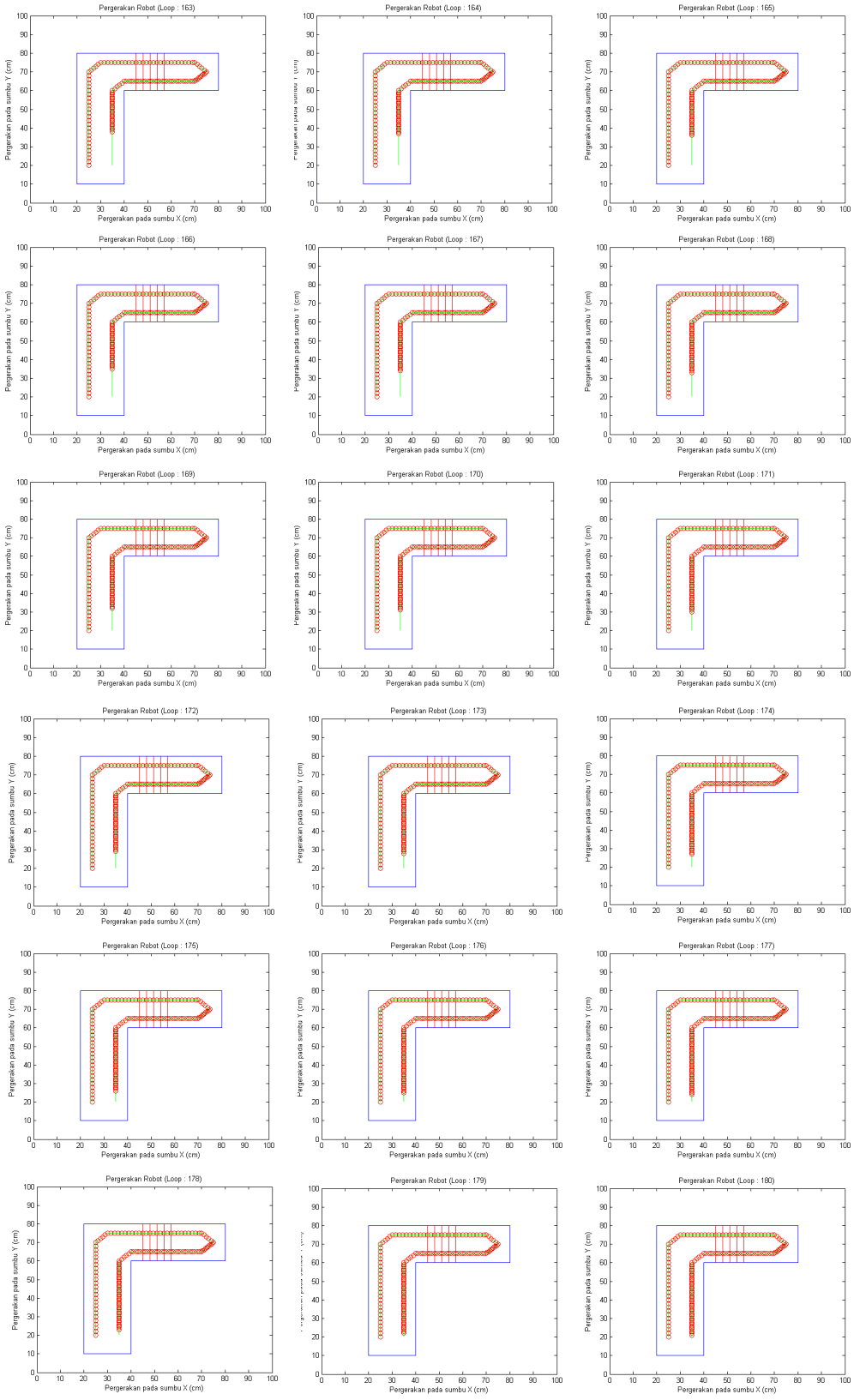
PERGERAKAN MOBILE ROBOT HASIL SIMULASI *(Lanjutan)*



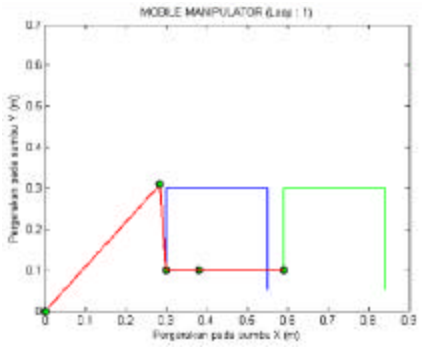
PERGERAKAN MOBILE ROBOT HASIL SIMULASI *(Lanjutan)*

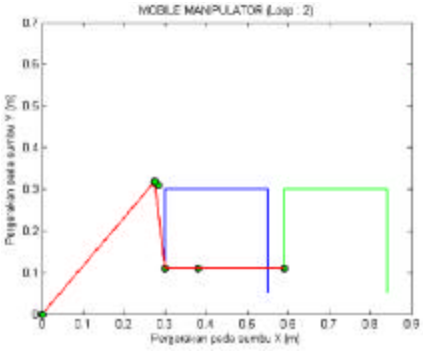


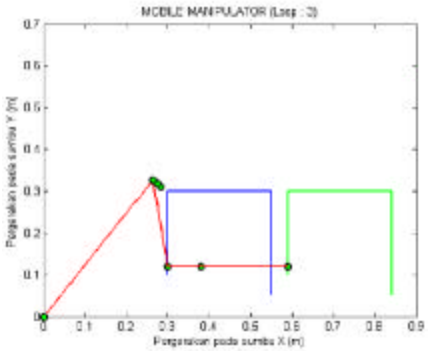
PERGERAKAN MOBILE ROBOT HASIL SIMULASI *(Lanjutan)*

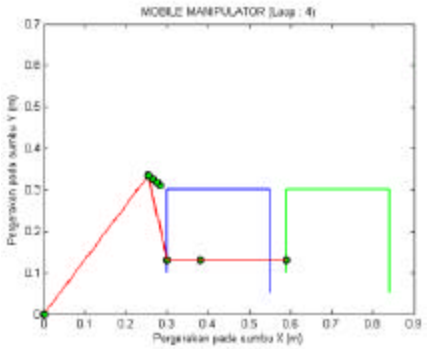


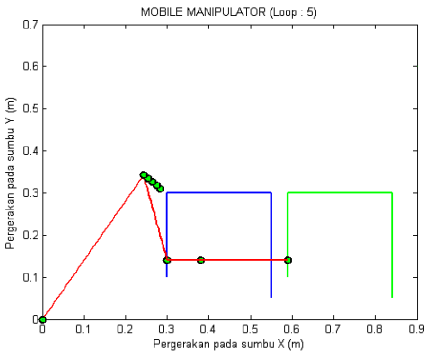
PERGERAKAN MANIPULATOR ROBOT HASIL SIMULASI

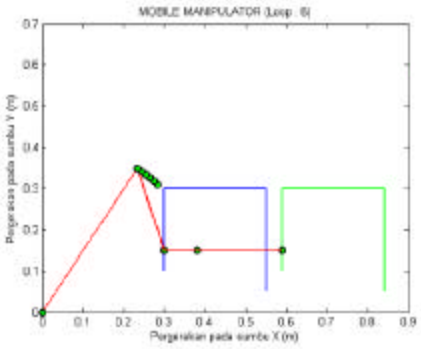


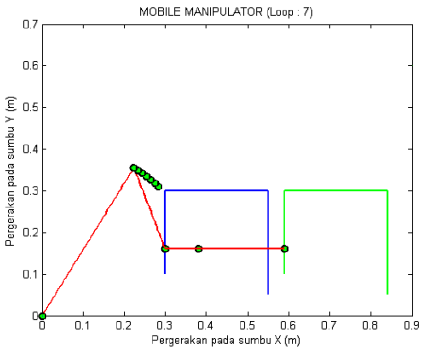


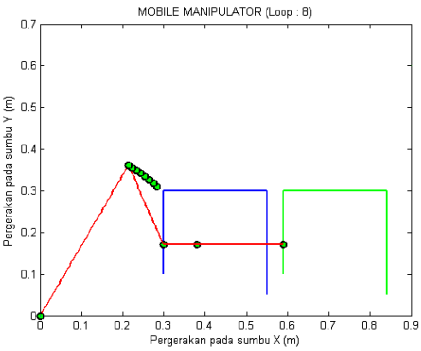




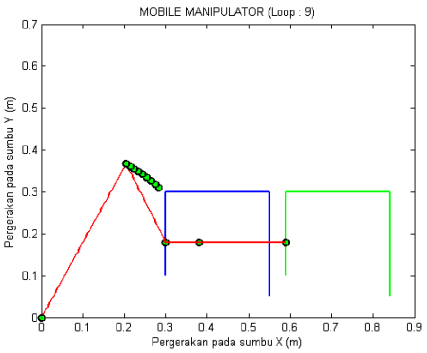


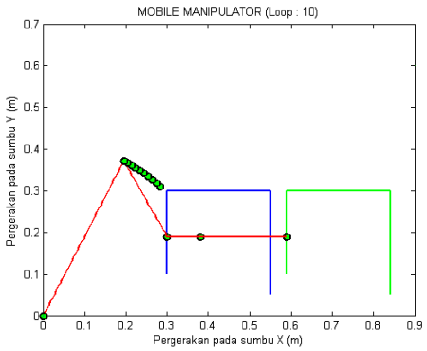


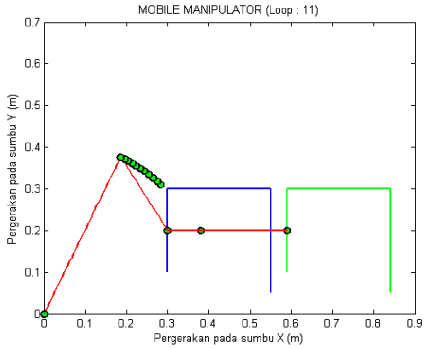


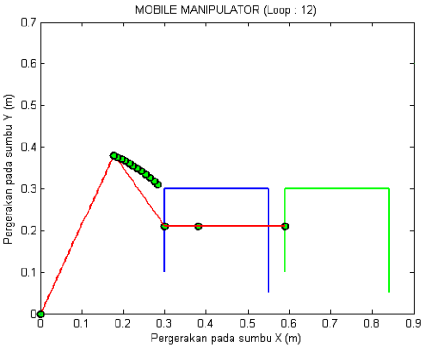


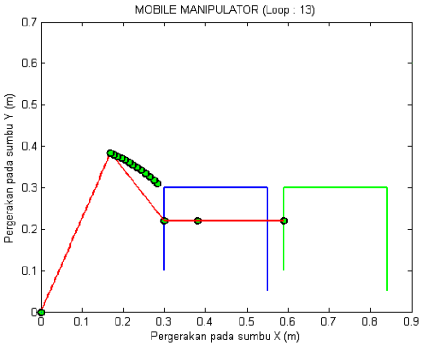
PERGERAKAN MANIPULATOR ROBOT HASIL SIMULASI *(Lanjutan)*

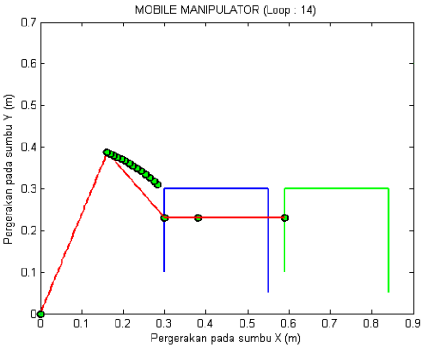


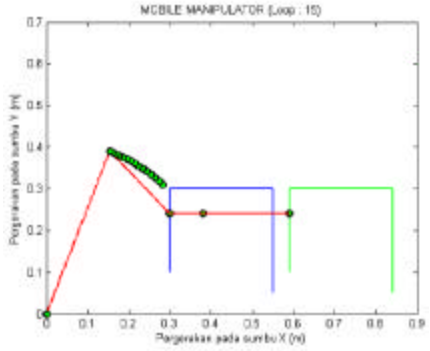


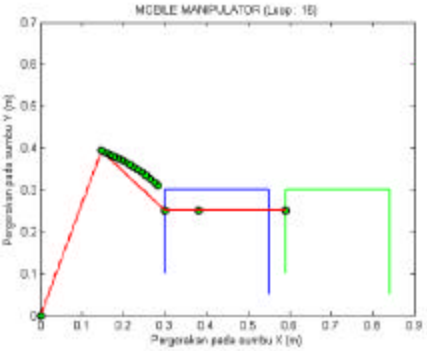




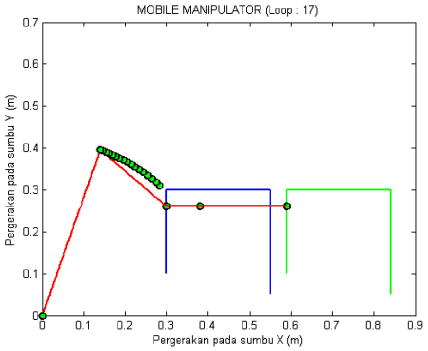


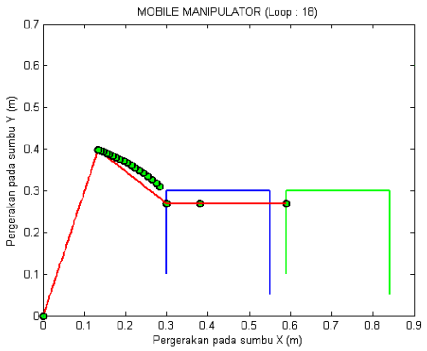


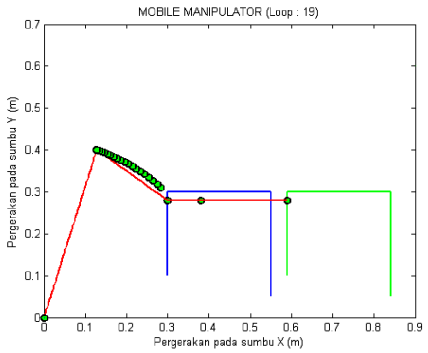


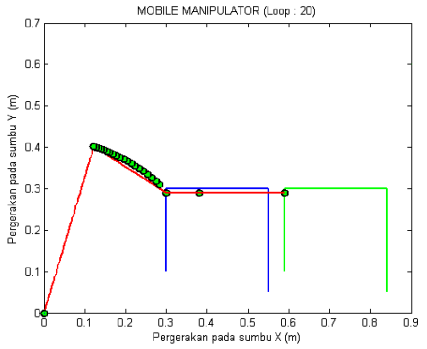


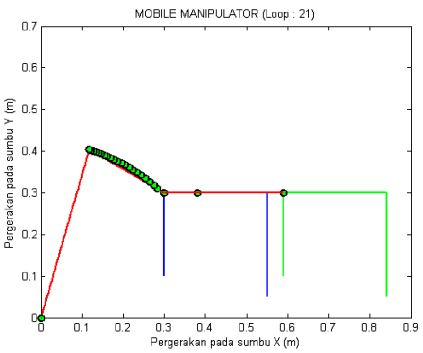
PERGERAKAN MANIPULATOR ROBOT HASIL SIMULASI *(Lanjutan)*

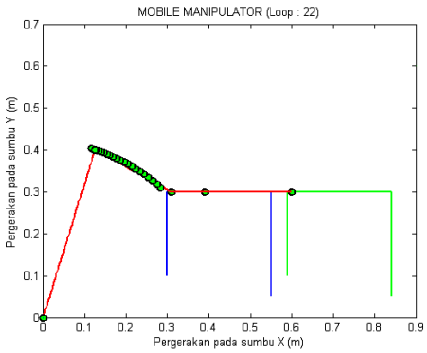


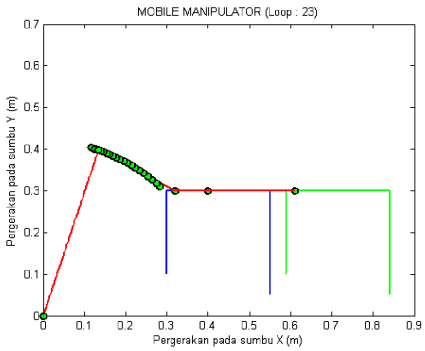


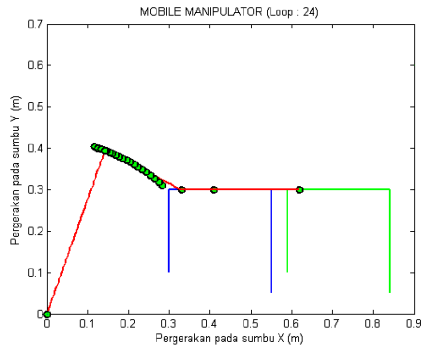




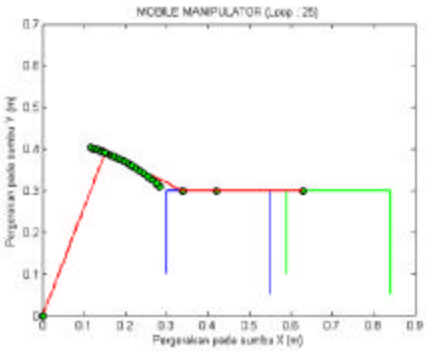


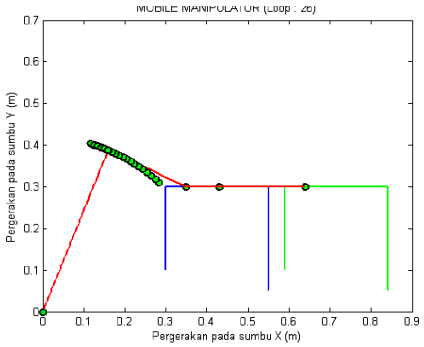


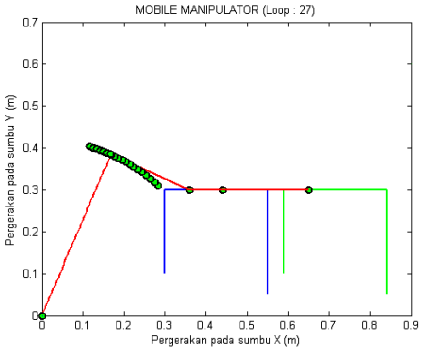


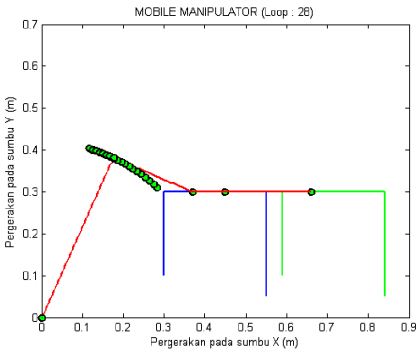


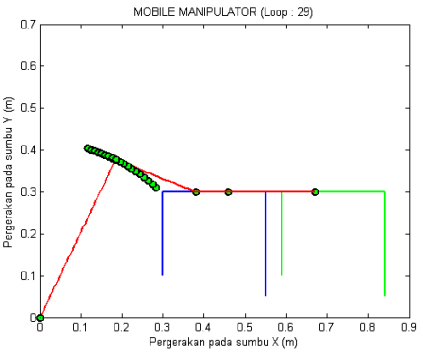
PERGERAKAN MANIPULATOR ROBOT HASIL SIMULASI *(Lanjutan)*

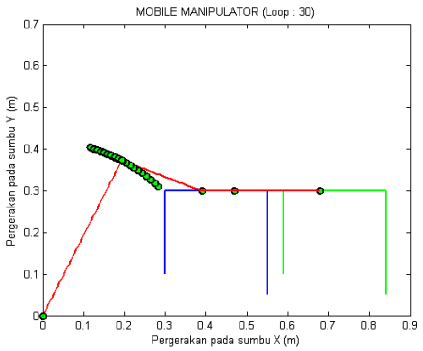


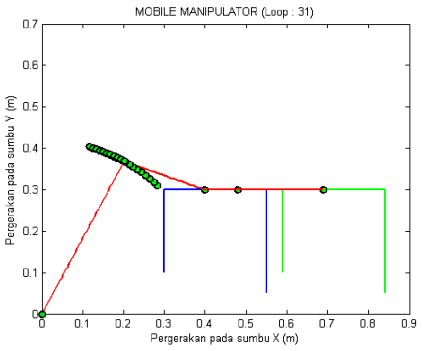


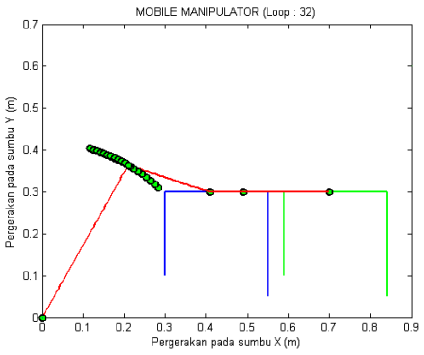




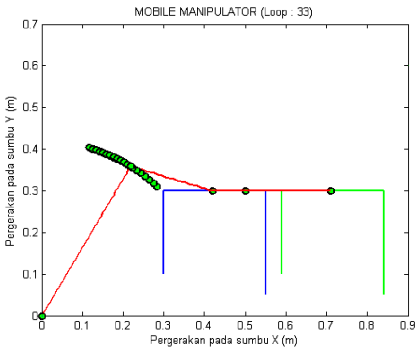


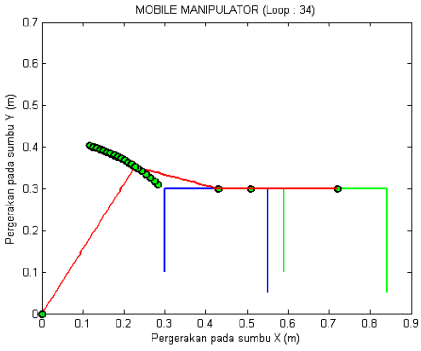


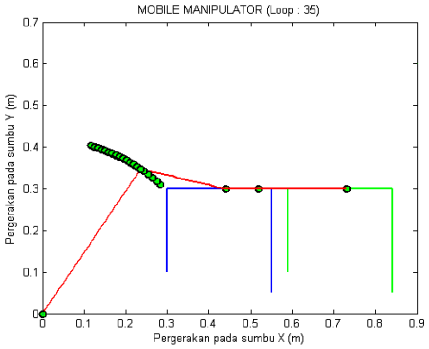


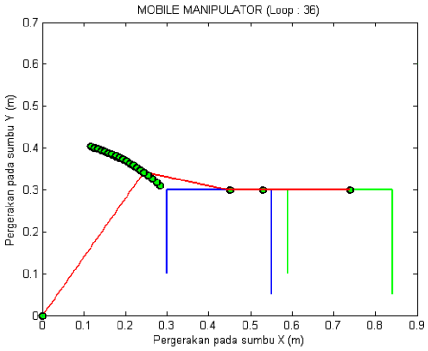


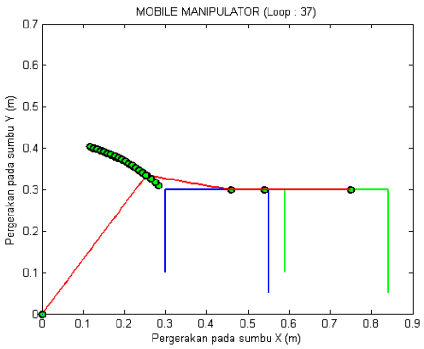
PERGERAKAN MANIPULATOR ROBOT HASIL SIMULASI *(Lanjutan)*

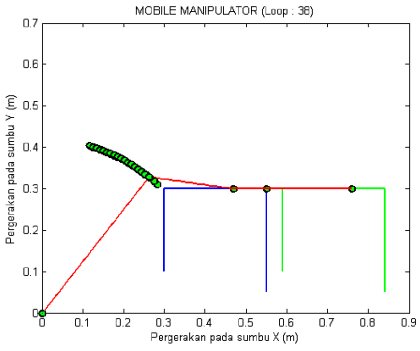


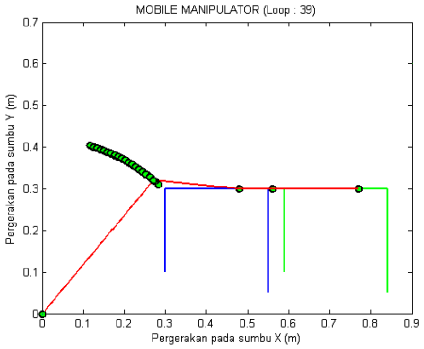


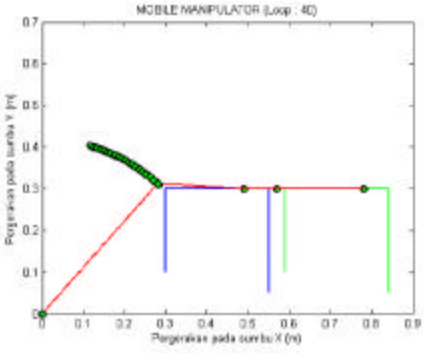




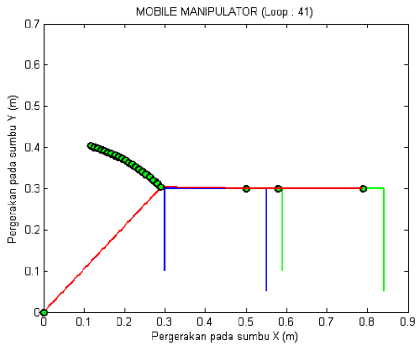


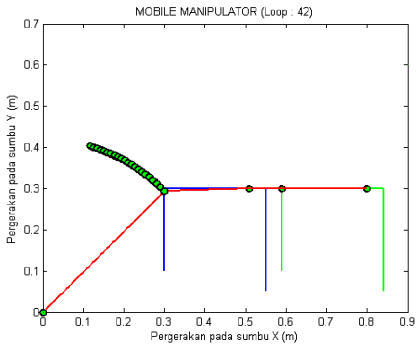


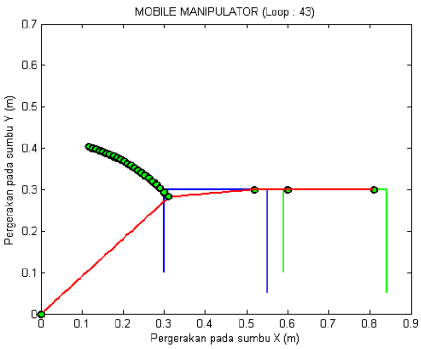


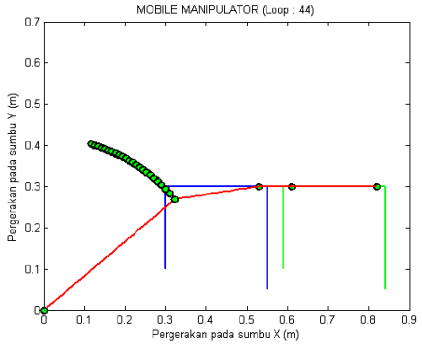


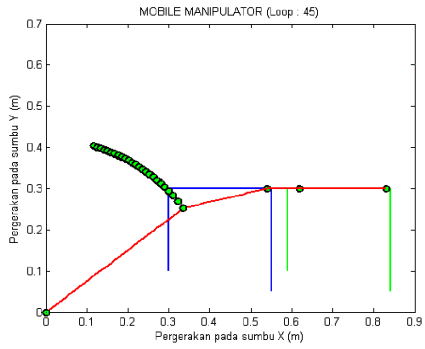
PERGERAKAN MANIPULATOR ROBOT HASIL SIMULASI *(Lanjutan)*

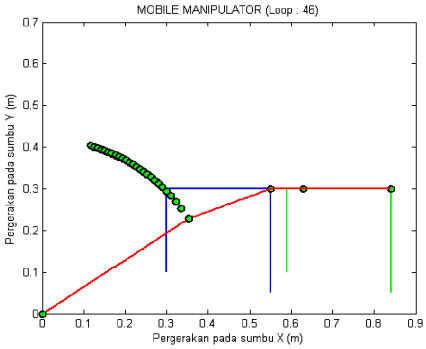


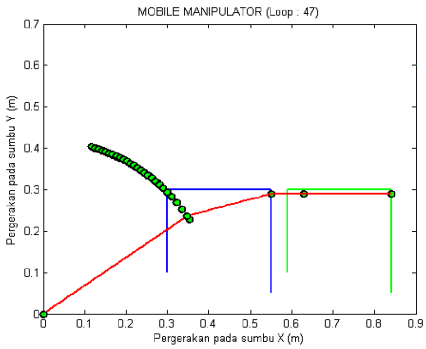


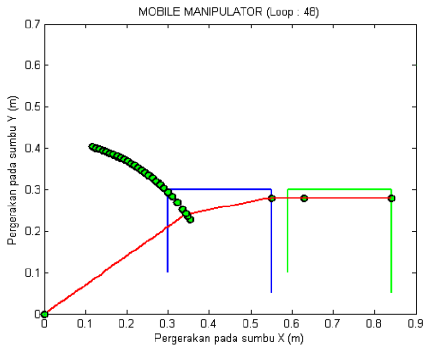




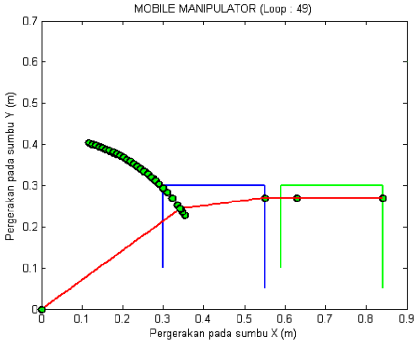


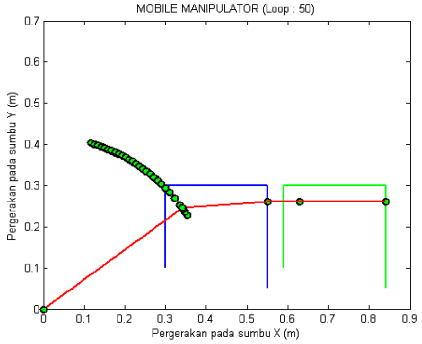


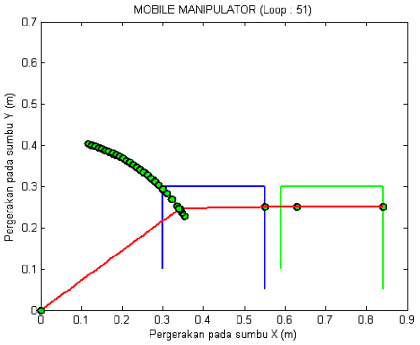


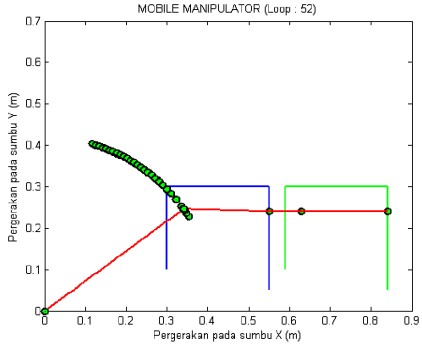


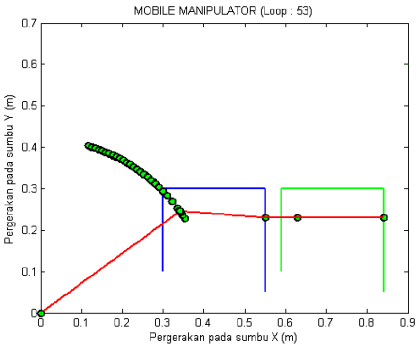
PERGERAKAN MANIPULATOR ROBOT HASIL SIMULASI *(Lanjutan)*

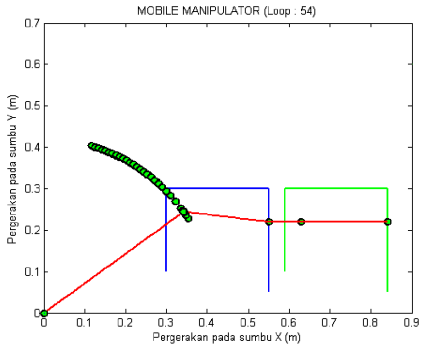


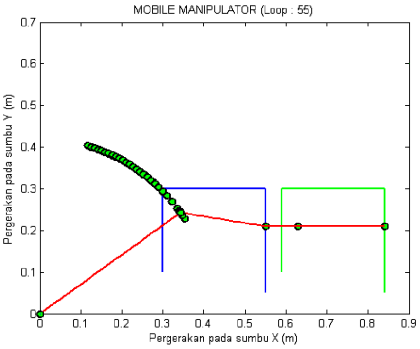


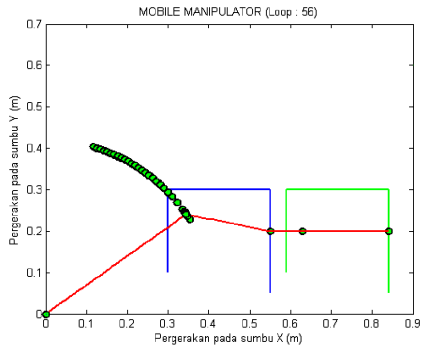




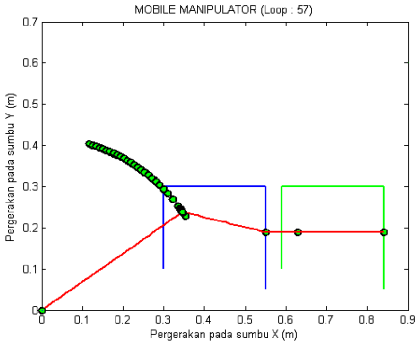


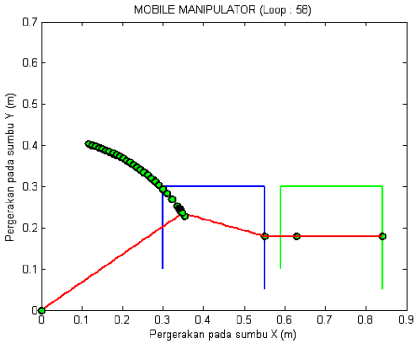


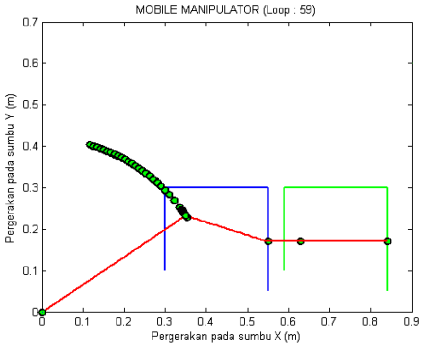


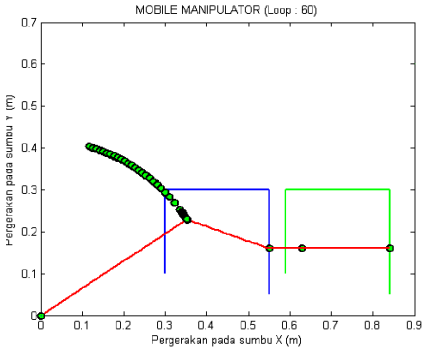


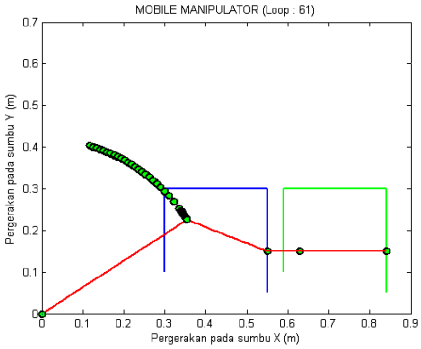
PERGERAKAN MANIPULATOR ROBOT HASIL SIMULASI *(Lanjutan)*

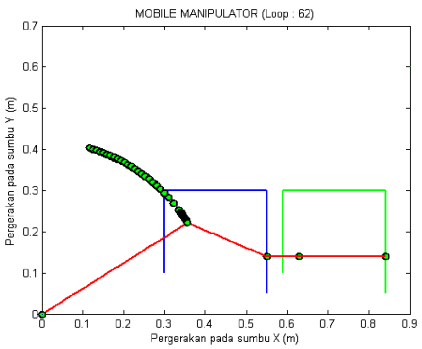


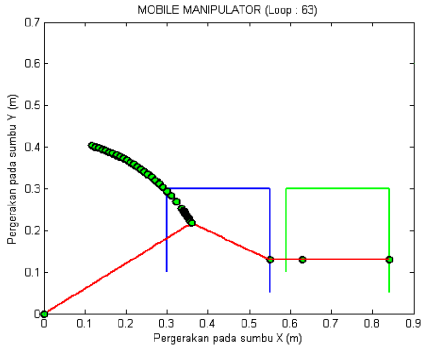


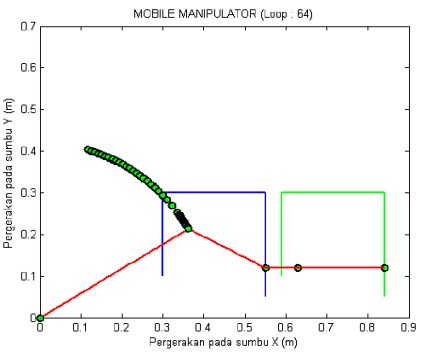




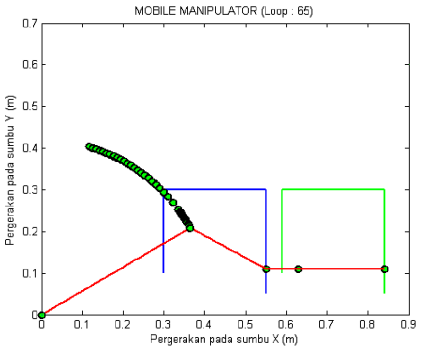


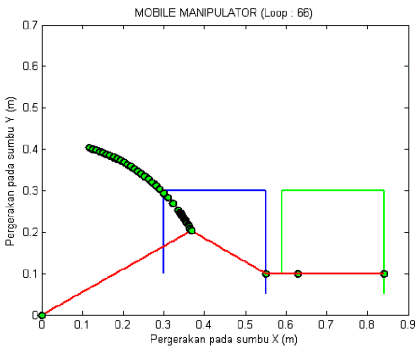


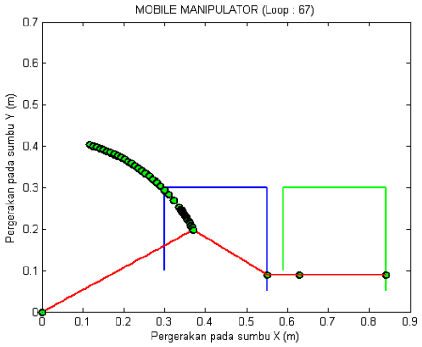


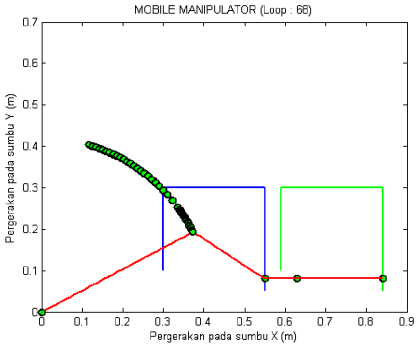


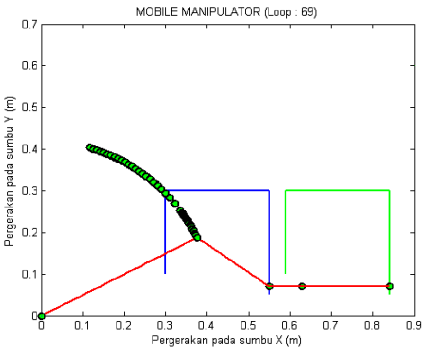
PERGERAKAN MANIPULATOR ROBOT HASIL SIMULASI *(Lanjutan)*

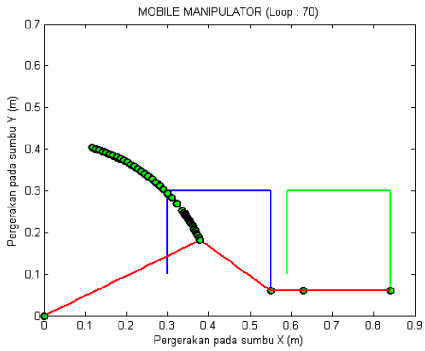












```
clc
clear all
%=====================================================
%   TRAJECTORY (LINTASAN)
%-----------------------------------------------------

%=====================================================
%Buat Lintasan
nn=1;
for i=0.1:0.01:0.3;
    yp(nn)=i;
    xp(nn)=0.3;
    yl(nn)=i;
    xl(nn)=xp(nn)+0.29;
    nn=nn+1;
end;
nn=nn-1;
for i=0.3:0.01:0.55;
    yp(nn)=0.3;
    xp(nn)=i;
    yl(nn)=0.3;
    xl(nn)=i+0.29;
    nn=nn+1;
end;
nn=nn-1;
for i=0:0.01:0.25;
    yp(nn)=abs(i-0.3);
    xp(nn)=0.55;
    yl(nn)=yp(nn);
    xl(nn)=xp(nn)+0.29;
    nn=nn+1;
end;

%*****************************************************
%   FORMULA
%-----------------------------------------------------
%Masukan awal
l1=0.42;  %Panjang lengan 1
l2=0.21;  %Panjang lengan 2
l3=0.08;  %Panjang lengan 3
l4=0.21;  %Panjang lengan 4
no=1;
nox=1;
while no<=nn
%*****************************************************
%   FORMULA MENDAPATKAN KINEMATIK INVERS
%-----------------------------------------------------
    teta2(no)=-acosd(((xp(no)^2)+(yp(no)^2)-(l1^2)-
(l2^2))/(2*l1*l2));
```



```
    k1(no)=l1+l2*cosd(teta2(no));
```

```
    k2(no)=l2*sind(teta2(no));
    r(no)=sqrt((k1(no)^2)+(k2(no)^2));
    teta1(no)=acosd(xp(no)/r(no))-(-acosd(k1(no)/r(no)));
    lamda1(no)=teta1(no)+teta2(no);
    teta3(no)=0;
    teta4(no)=0;
%*************************************************
%   STRUKTUR LENGAN #1
%-------------------------------------------------
noo(no)=no;
n=1;
dbuffx1=0;                      %Initial point sb.x
dbuffy1=0;                      %Initial point sb.y
for i=0:0.01:l1;                 %Panjang Lengan
    z1(n)=i;
    x1(n)=(z1(n)*cosd(teta1(no)))+dbuffx1;
    y1(n)=(z1(n)*sind(teta1(no)))+dbuffy1;
    bbuffx1=x1(n);               %End point sb.x
    bbuffy1=y1(n);               %End point sb.y
    n=n+1;
end;
bbuffxx1(no)=bbuffx1;
bbuffyy1(no)=bbuffy1;
%*************************************************
%   STRUKTUR LENGAN #2
%-------------------------------------------------
n=1;
dbuffx2=bbuffx1;                %Initial point sb.x
dbuffy2=bbuffy1;                %Initial point sb.y
for i=0:0.01:l2;                 %Panjang Lengan
    z2(n)=i;
    x2(n)=(z2(n)*cosd(lamda1(no)))+dbuffx2;
    y2(n)=(z2(n)*sind(lamda1(no)))+dbuffy2;
    bbuffx2=x2(n);               %End point sb.x
    bbuffy2=y2(n);               %End point sb.y
    n=n+1;
end;
bbuffxx2(no)=bbuffx2;
bbuffyy2(no)=bbuffy2;
%*************************************************
%   STRUKTUR LENGAN #3
%-------------------------------------------------
n=1;
dbuffx3=bbuffx2;                %Initial point sb.x
dbuffy3=bbuffy2;                %Initial point sb.y
for i=0:0.01:l3;                 %Panjang Lengan
    z3(n)=i;
    x3(n)=(z3(n)*cosd(teta3(no)))+dbuffx3;
    y3(n)=(z3(n)*sind(teta3(no)))+dbuffy3;
10/19/08  5:01 PM  D:\Matlab Manipu …\rumus asli mobile m     3 of
4

    bbuffx3=x3(n);               %End point sb.x
    bbuffy3=y3(n);               %End point sb.y
    n=n+1;
end;
```

```
bbuffxx3(no)=bbuffx3;
bbuffyy3(no)=bbuffy3;
%*****************************************************
%   STRUKTUR LENGAN #4
%-----------------------------------------------------
n=1;
dbuffx4=bbuffx3;                %Initial point sb.x
dbuffy4=bbuffy3;                %Initial point sb.y
for i=0:0.01:l4;                 %Panjang Lengan
    z4(n)=i;
    x4(n)=(z4(n)*cosd(teta4(no)))+dbuffx4;
    y4(n)=(z4(n)*sind(teta4(no)))+dbuffy4;
    bbuffx4=x4(n);                %End point sb.x
    bbuffy4=y4(n);                %End point sb.y
    n=n+1;
end;
bbuffxx4(no)=bbuffx4;
bbuffyy4(no)=bbuffy4;
%gcf=figure; %Aktifkan bila ingin mengambil gambar
%*****************************************************
%   PLOT KE LAYAR
%-----------------------------------------------------
bbuffxx2(no)=bbuffx2;
bbuffyy2(no)=bbuffy2;
gerakx(no,nox+1)=dbuffx1;
geraky(no,nox+1)=dbuffy1;
gerakx(no,nox+2)=bbuffx1;
geraky(no,nox+2)=bbuffy1;
gerakx(no,nox+4)=bbuffx1;
geraky(no,nox+4)=bbuffy1;
gerakx(no,nox+5)=dbuffx1;
geraky(no,nox+5)=dbuffy1;
plot(xp,yp,'b-',...
    xl,yl,'g-',...
    dbuffx1,dbuffy1,'mo',...
    bbuffx1,bbuffy1,'mo',...    %Lengan #1
    bbuffx2,bbuffy2,'go',...    %Lengan #2
    bbuffx3,bbuffy3,'ro',...    %Lengan #3
    bbuffx4,bbuffy4,'ro',...    %Lengan #4
    x1,y1,'r-',...              %Posisi Lengan #1
    x2,y2,'r-',...              %Posisi Lengan #2
    x3,y3,'r-',...              %Posisi Lengan #3
    x4,y4,'r-',...              %Posisi Lengan #4
    gerakx,geraky,'ro',...
    0,0,0.9,0.6,...
```



```
                'LineWidth',2,...
                'MarkerEdgeColor','k',...
                'MarkerFaceColor','g',...
                'MarkerSize',7);
xlabel('Pergerakan pada sumbu X (m)');
ylabel('Pergerakan pada sumbu Y (m)');
title(['MOBILE MANIPULATOR (Loop : ',num2str(no),')'])
```

```
%*************************************************
deltat=0.02;
durasi(no)=noo(no)*0.02;
no=no+1;                          %TRANTITION GENERATOR
nox=nox+1;
pause(0.000000001);                       %ANIMATE GENERATOR
end;
```