

# Kalman Filter

2019.03.18

# 차례

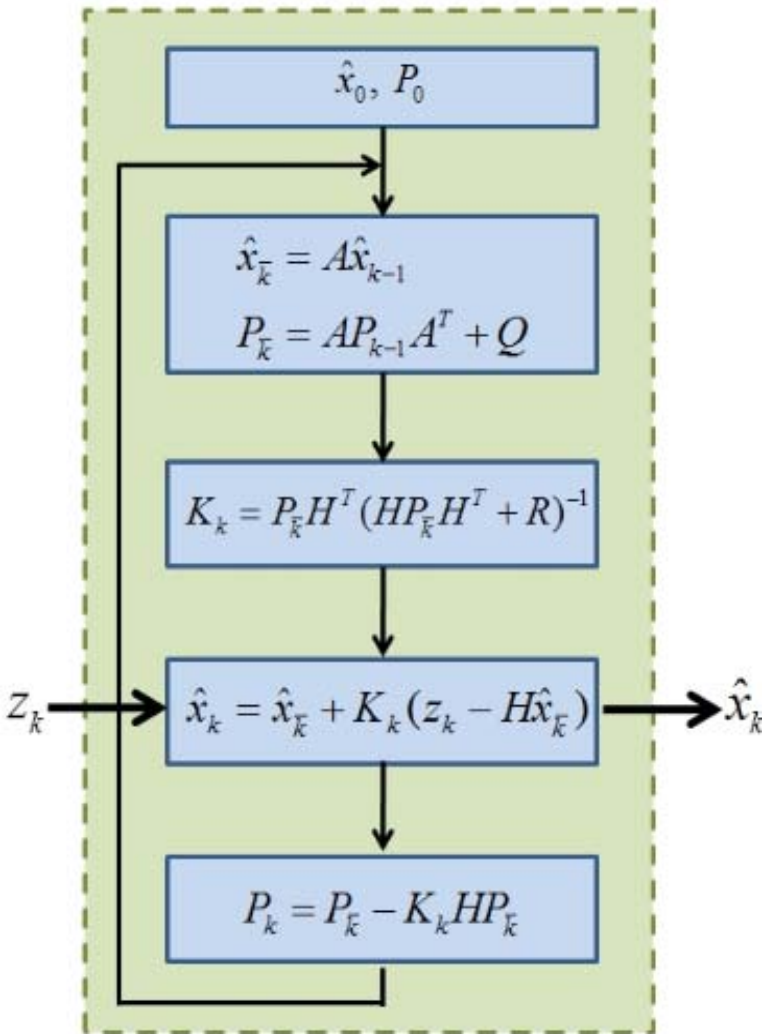
## 1. 프로그램

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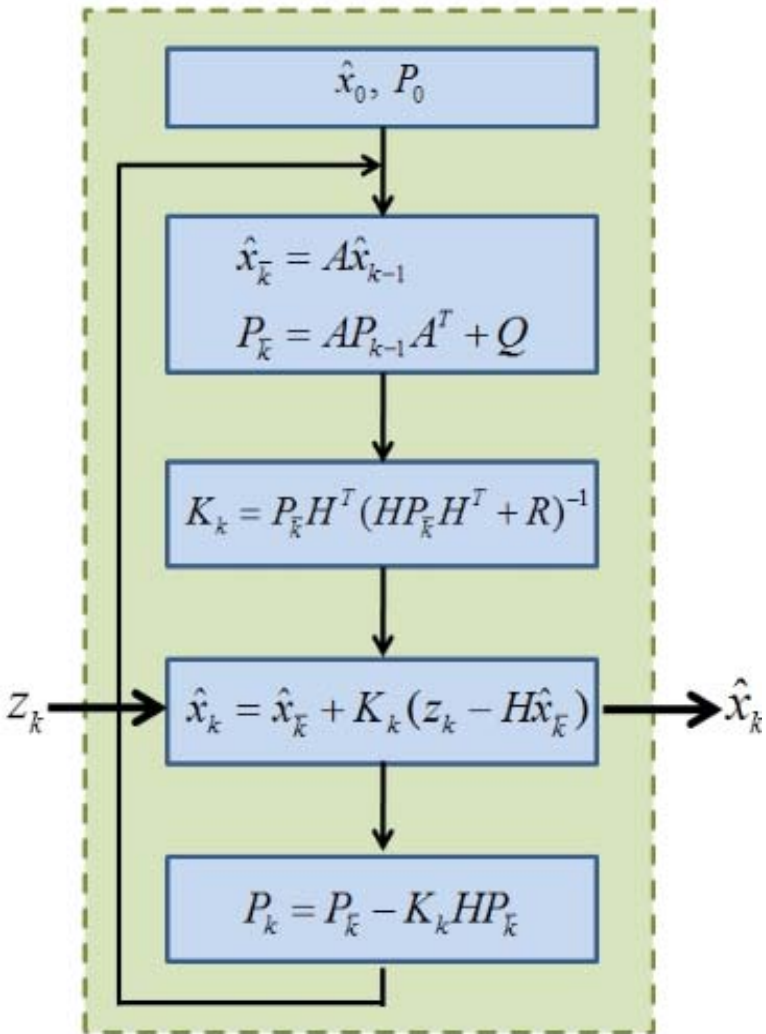


# 1. 프로그램



Kalman Filter algorithm

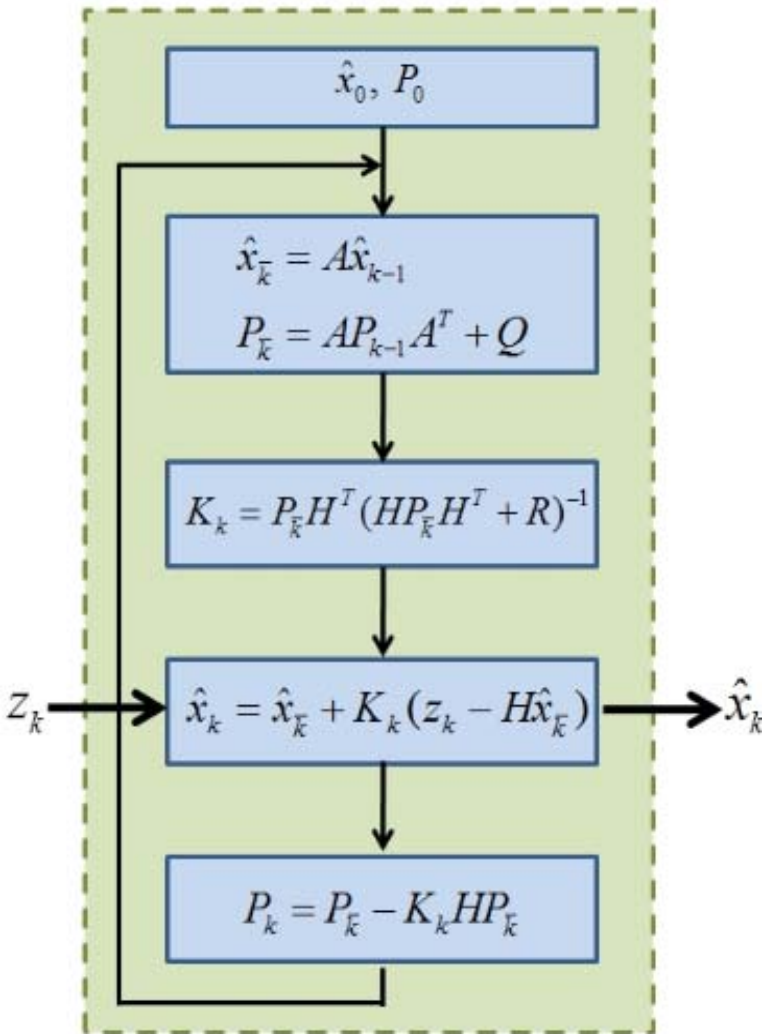
# 1. 프로그램



Kalman Filter algorithm

$$x_k = 14$$

# 1. 프로그램

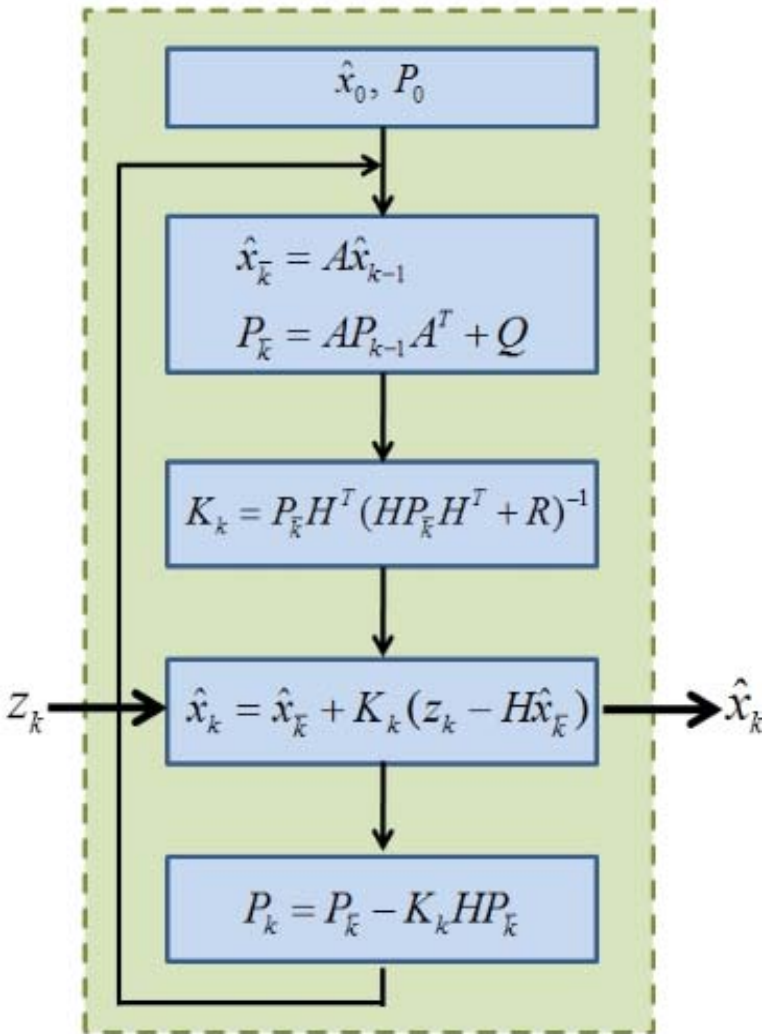


Kalman Filter algorithm

$$x_k = 14$$

$$v_k = N(0, 2^2)$$

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Kalman Filter algorithm

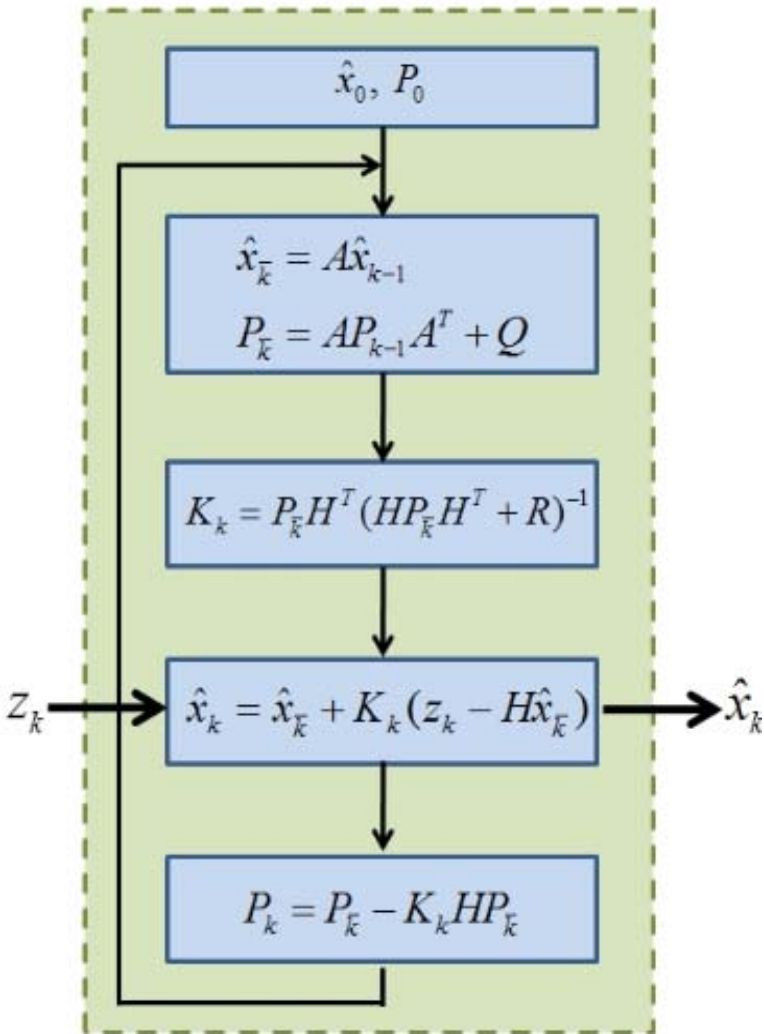
$$x_{k+1} = x_k$$

$$x_k = 14$$

$$v_k = N(0, 2^2)$$



# 1. 프로그램



Kalman Filter algorithm

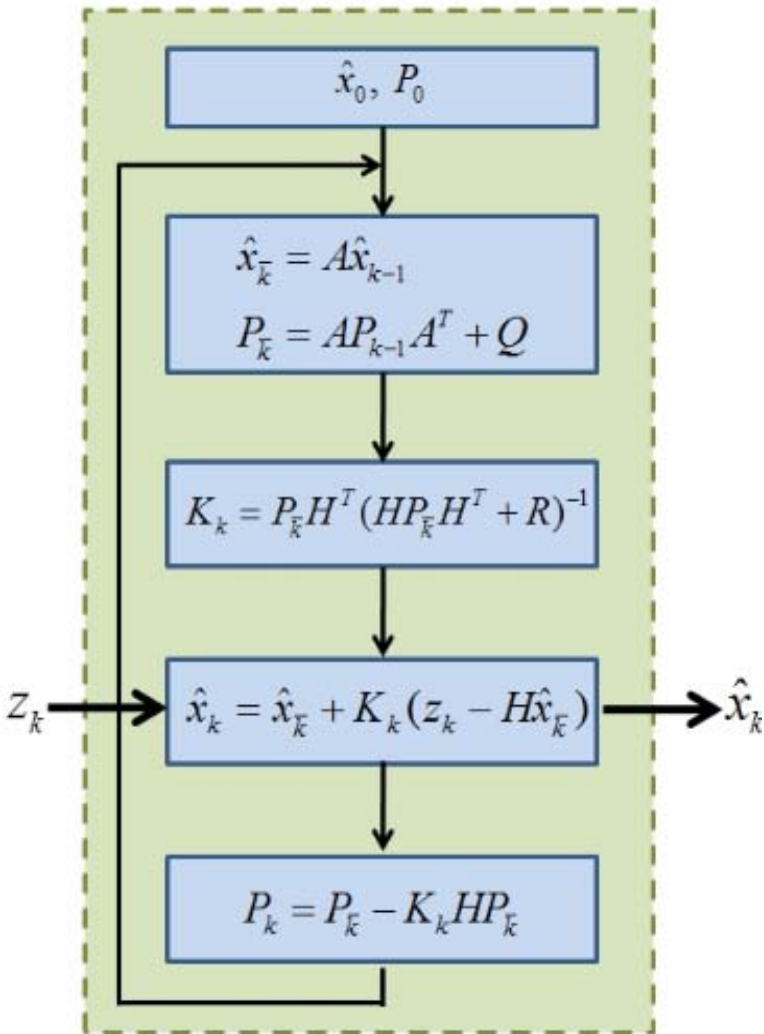
$$x_{k+1} = x_k$$

$$z_k = x_k + v_k$$

$$x_k = 14$$

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# 1. 프로그램



Kalman Filter algorithm

$$x_{k+1} = x_k$$

$$z_k = x_k + v_k$$

$$x_{k+1} = Ax_k + w_k$$

$$z_k = Hx_k + v_k$$

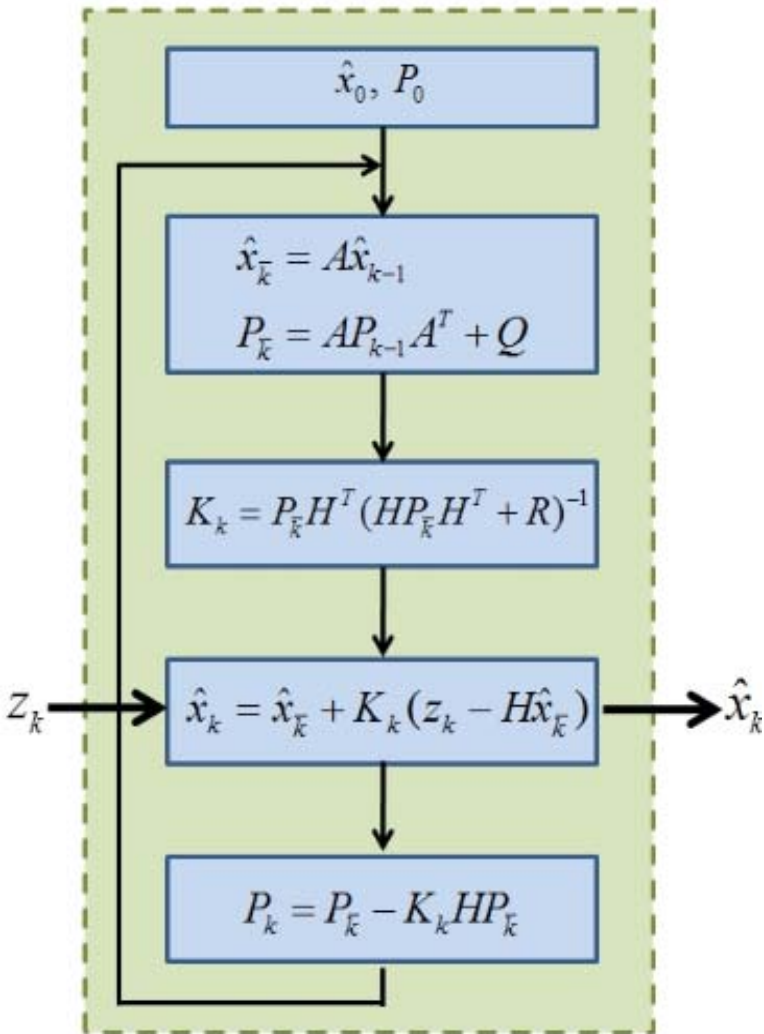
$$x_k = 14$$

$$v_k = N(0, 2^2)$$

$Q = w_k$ 의 공분산 행렬

$R = v_k$ 의 공분산 행렬

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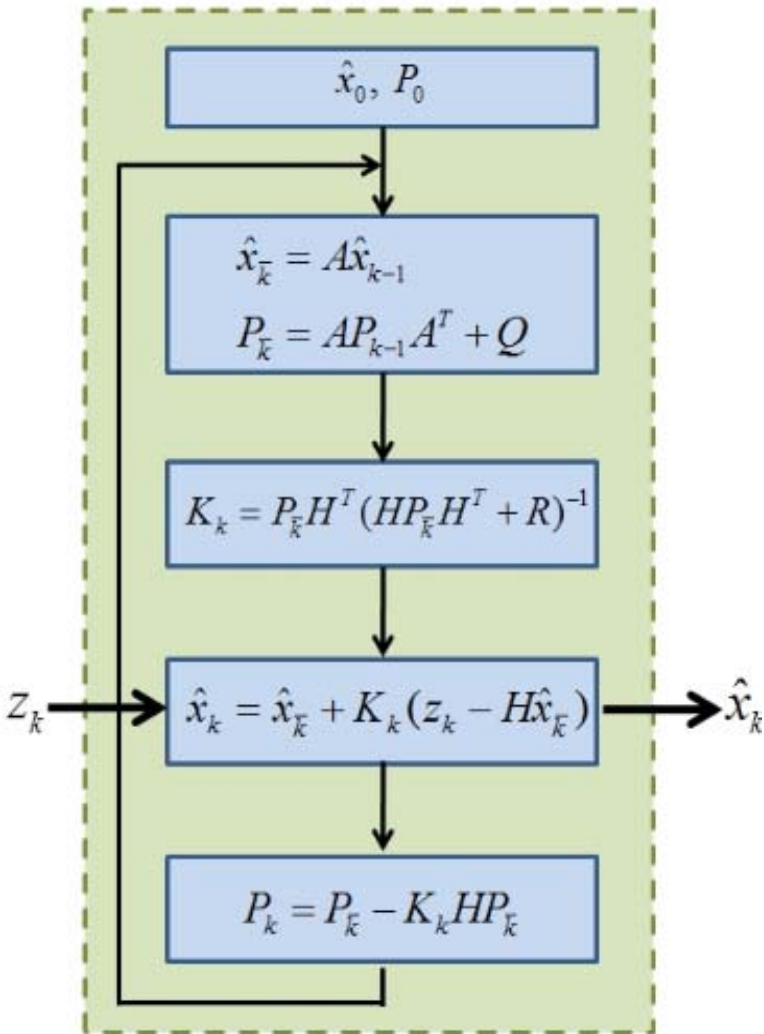
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Kalman Filter algorithm

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$$x_k = 14$$

$$z_k = x_k + v_k$$

$$v_k = N(0, 2^2)$$

$$x_{k+1} = A x_k + w_k$$

$Q = w_k$ 의 공분산 행렬

$$z_k = H x_k + v_k$$

$R = v_k$ 의 공분산 행렬

$x_k$ 는 상태 변수

$z_k$ 는 측정값

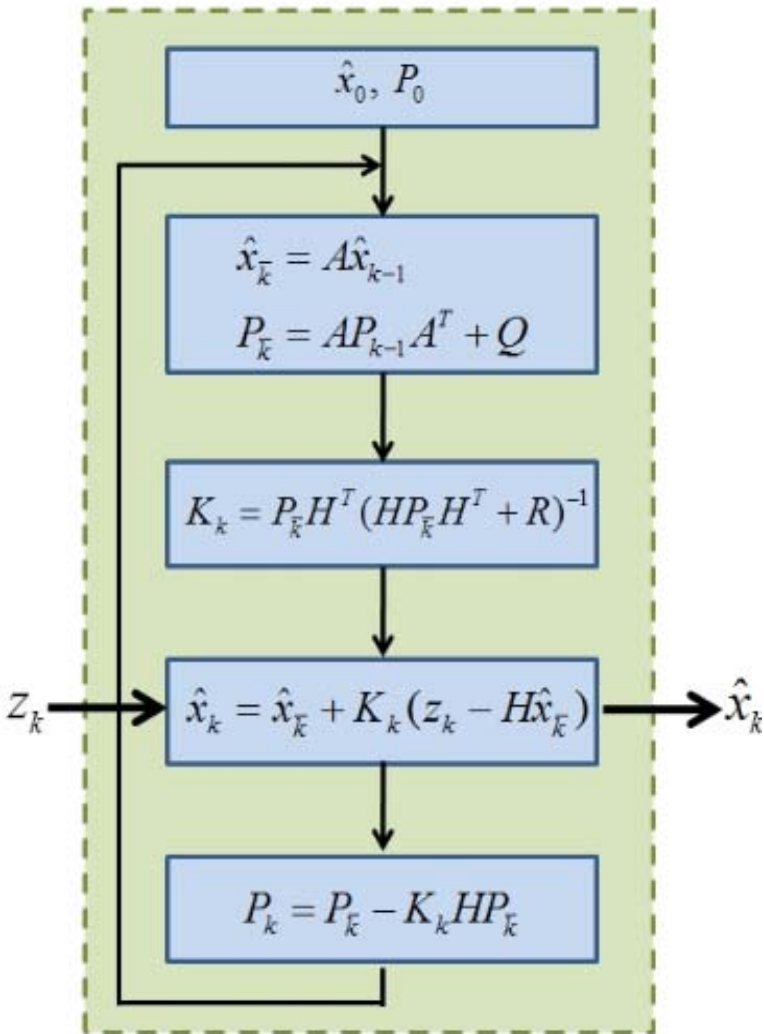
$A$ 는 상태전이행렬

$H$ 는  $m \times n$  행렬

$w_k$ 는 잡음

$v_k$ 는 측정 잡음

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Kalman Filter algorithm

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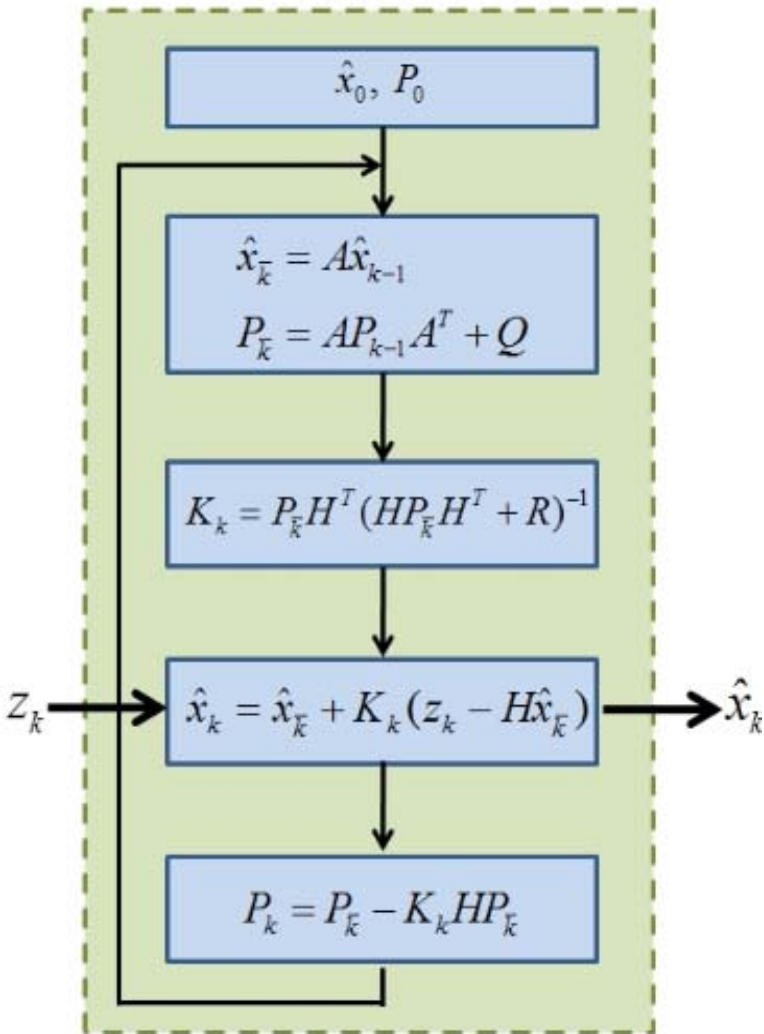
$H$ 는  $m \times n$  행렬

$w_k$ 는 잡음

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$$A = 1$$

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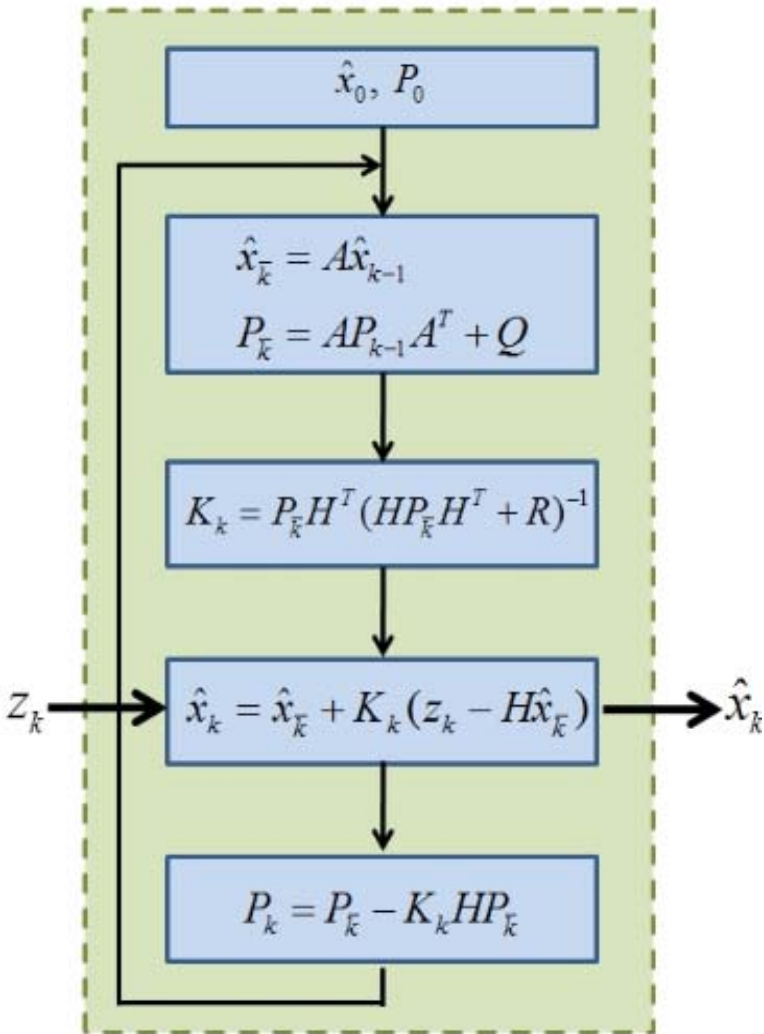
$w_k$ 는 잡음

$v_k$ 는 측정 잡음

$$A = 1$$

$$H = 1$$

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Kalman Filter algorithm

$$x_{k+1} = x_k$$

$$z_k = x_k + v_k$$

$$x_{k+1} = A x_k + w_k$$

$$z_k = H x_k + v_k$$

$x_k$ 는 상태 변수

$z_k$ 는 측정값

$A$ 는 상태전이행렬

$H$ 는  $m \times n$  행렬

$w_k$ 는 잡음

$w_k$ 는 측정 잡음

$$x_k = 14$$

$$v_k = N(0, 2^2)$$

$Q = w_k$ 의 공분산 행렬

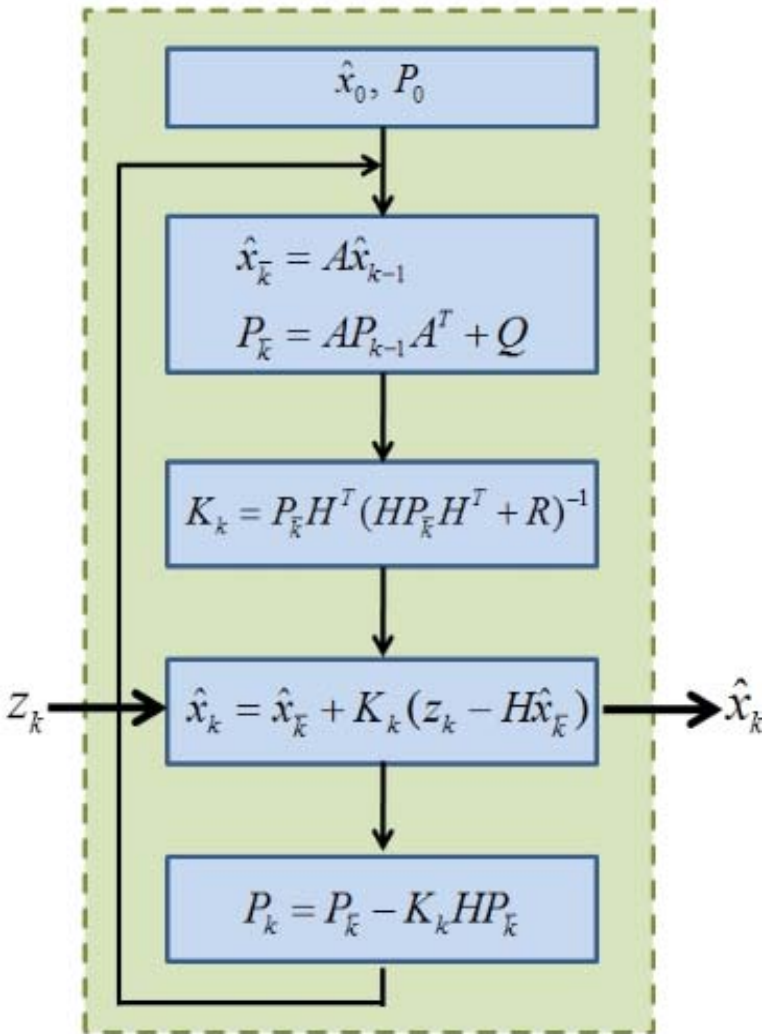
$R = v_k$ 의 공분산 행렬

$$A = 1$$

$$H = 1$$

$$Q = 0$$

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$$x_k = 14$$

$$v_k = N(0, 2^2)$$

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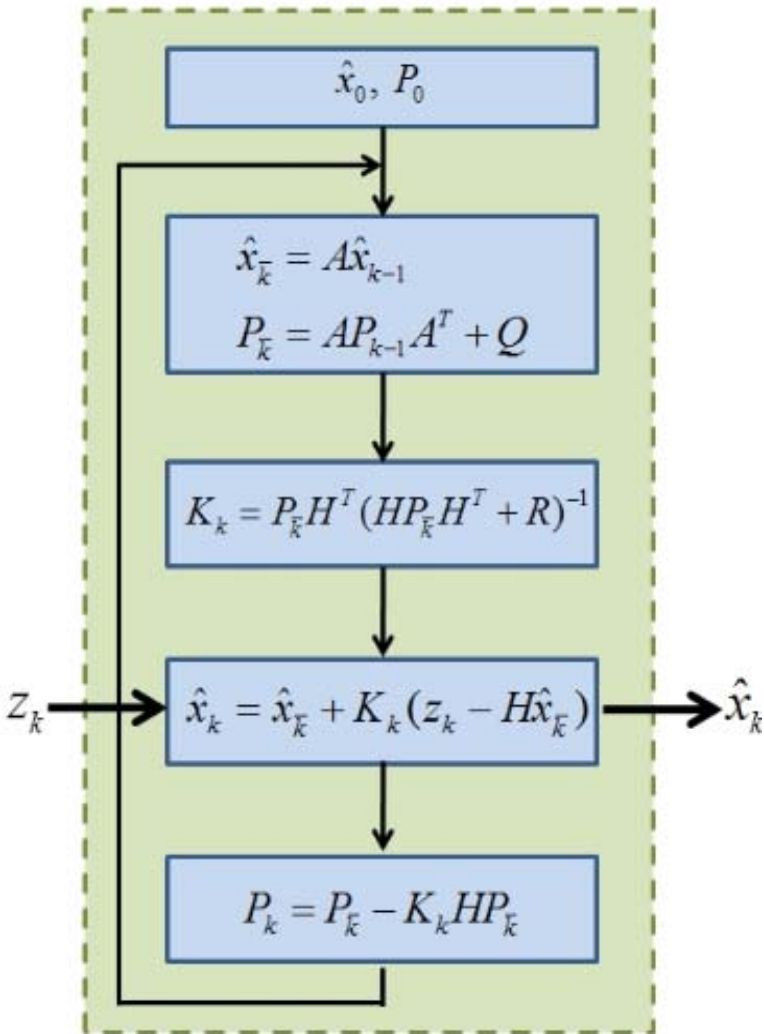
$$H = 1$$

$$Q = 0$$

$$R = 4$$



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Kalman Filter algorithm

$$x_{k+1} = x_k$$

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$$z_k = H x_k + v_k$$

$x_k$ 는 상태 변수

$z_k$ 는 측정값

$A$ 는 상태전이행렬

$H$ 는  $m \times n$  행렬

$w_k$ 는 잡음

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$$x_k = 14$$

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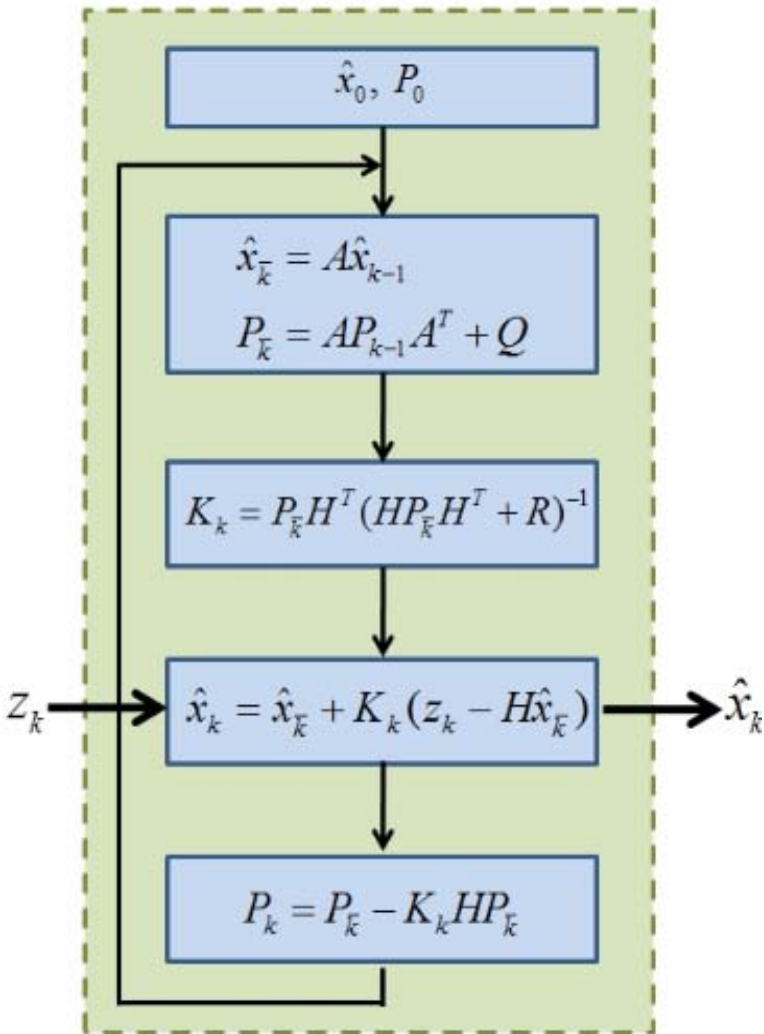
$$A = 1 \quad \hat{x}_0^- = 14$$

$$H = 1$$

$$Q = 0$$

$$R = 4$$

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Kalman Filter algorithm

$$x_{k+1} = x_k$$

$$z_k = x_k + v_k$$

$$x_{k+1} = A x_k + w_k$$

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$x_k$ 는 상태 변수

$z_k$ 는 측정값

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$$x_k = 14$$

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$Q = w_k$ 의 공분산 행렬

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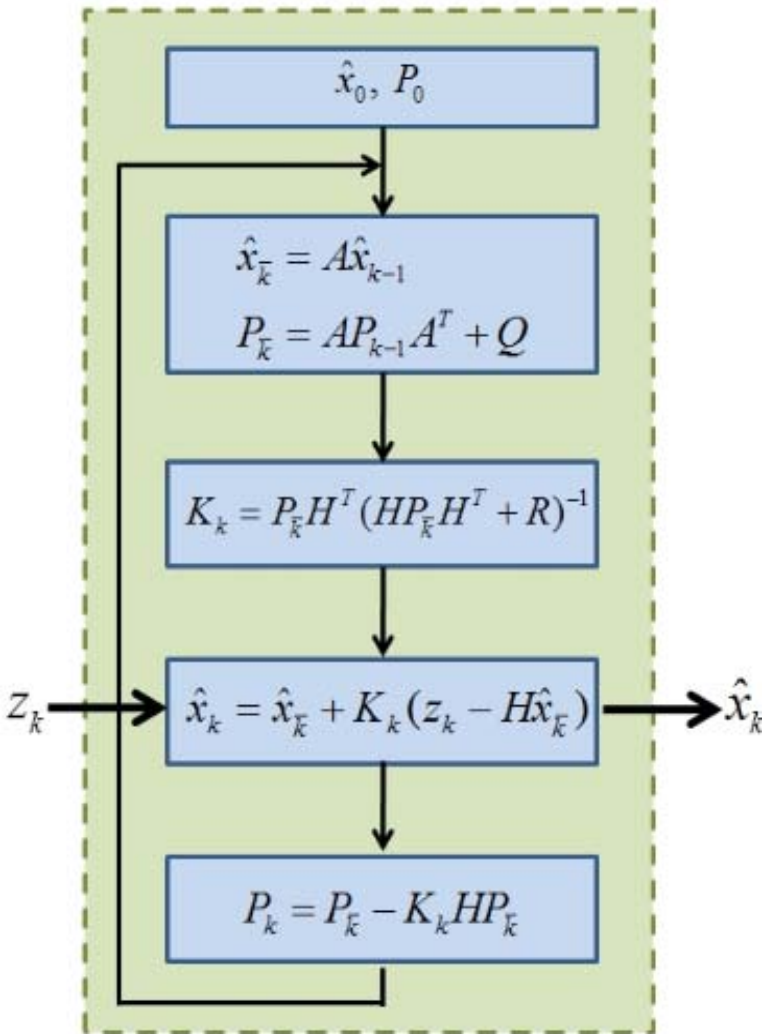
$$A = 1 \quad \hat{x}_0^- = 14$$

$$H = 1 \quad P_0 = 6$$

$$Q = 0$$

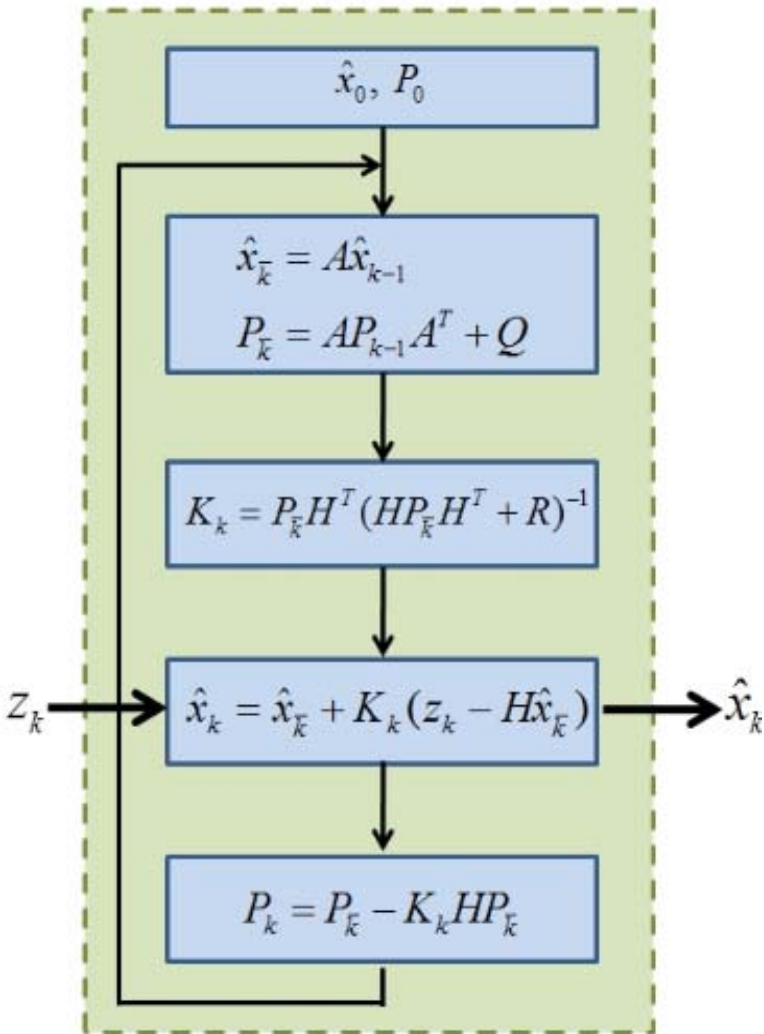
$$R = 4$$

# 1. 프로그램



Kalman Filter algorithm

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Kalman Filter algorithm

```
clear all
```

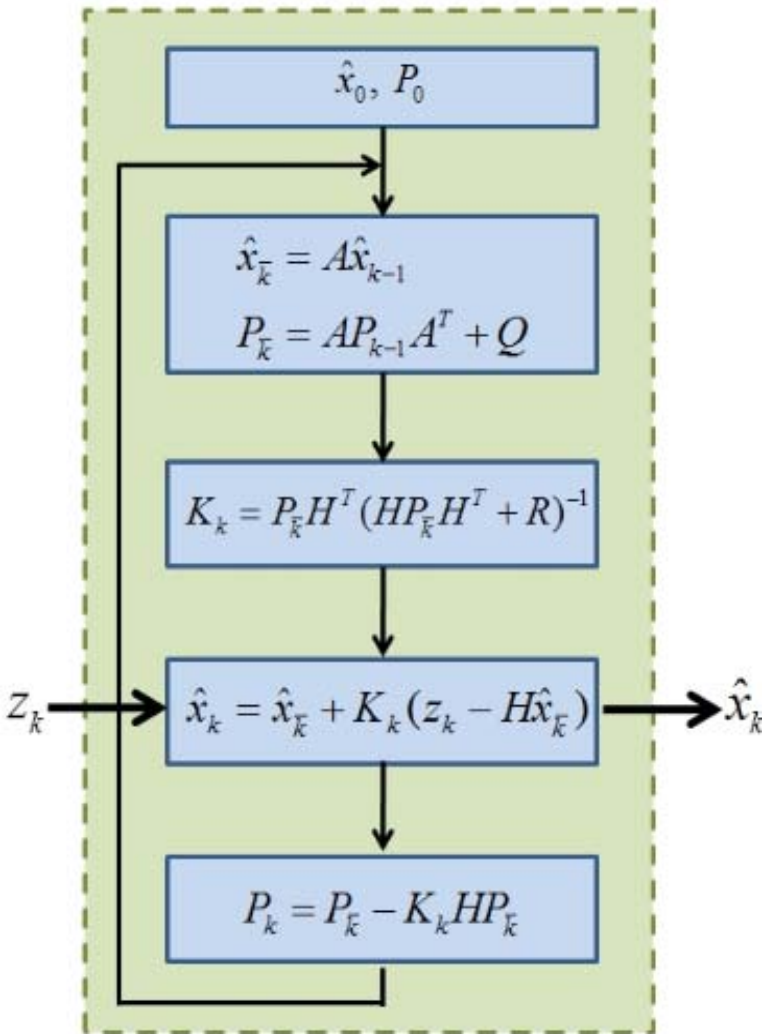
```
dt = 0.2;  
t = 0:dt:10;
```

```
Nsamples = length(t);  
Xsaved = zeros(Nsamples, 1);  
Zsaved = zeros(Nsamples, 1);
```

```
for k=1:Nsamples  
    z = GetVolt();  
    volt = SimpleKalman(z);  
    Xsaved(k) = volt;  
    Zsaved(k) = z;  
end
```

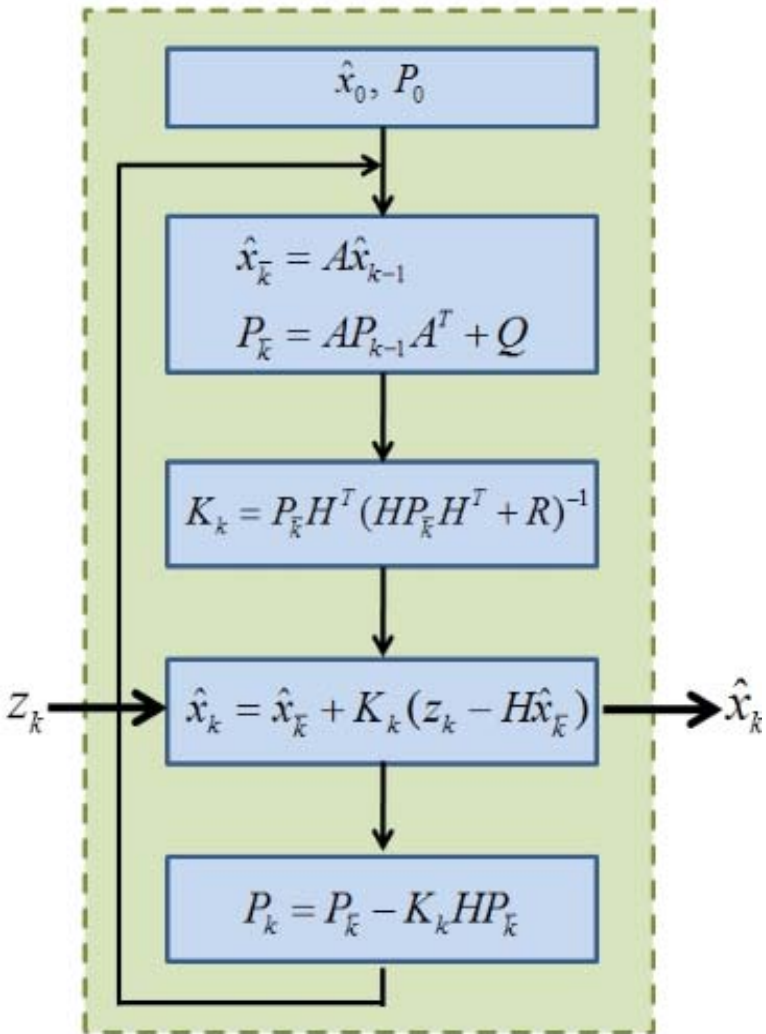
```
figure  
plot(t, Xsaved, 'o-')  
hold on  
plot(t, Zsaved, 'r:*')
```

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Kalman Filter algorithm

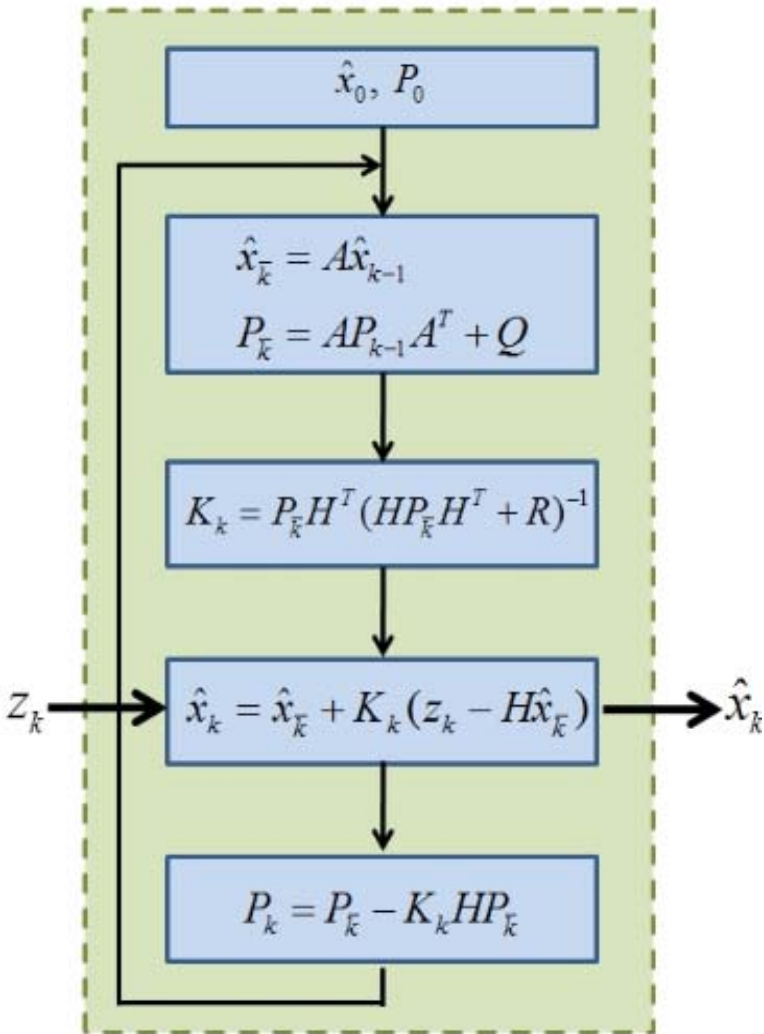
# 1. 프로그램



Kalman Filter algorithm

```
function z = GetVolt()  
%  
%  
w = 0 + 4*randn(1,1);  
z = 14.4 + w;
```

# 1. 프로그램



Kalman Filter algorithm

```

function z = GetVolt()
%
%
w = 0 + 4*randn(1,1);
z = 14.4 + w;
  
```

```

function volt = SimpleKalman(z)
%
persistent A H Q R
persistent x P
persistent firstRun

if isempty(firstRun)
    A = 1;
    H = 1;
    Q = 0;
    R = 4;

    x = 14;
    P = 6;

    firstRun = 1;
end

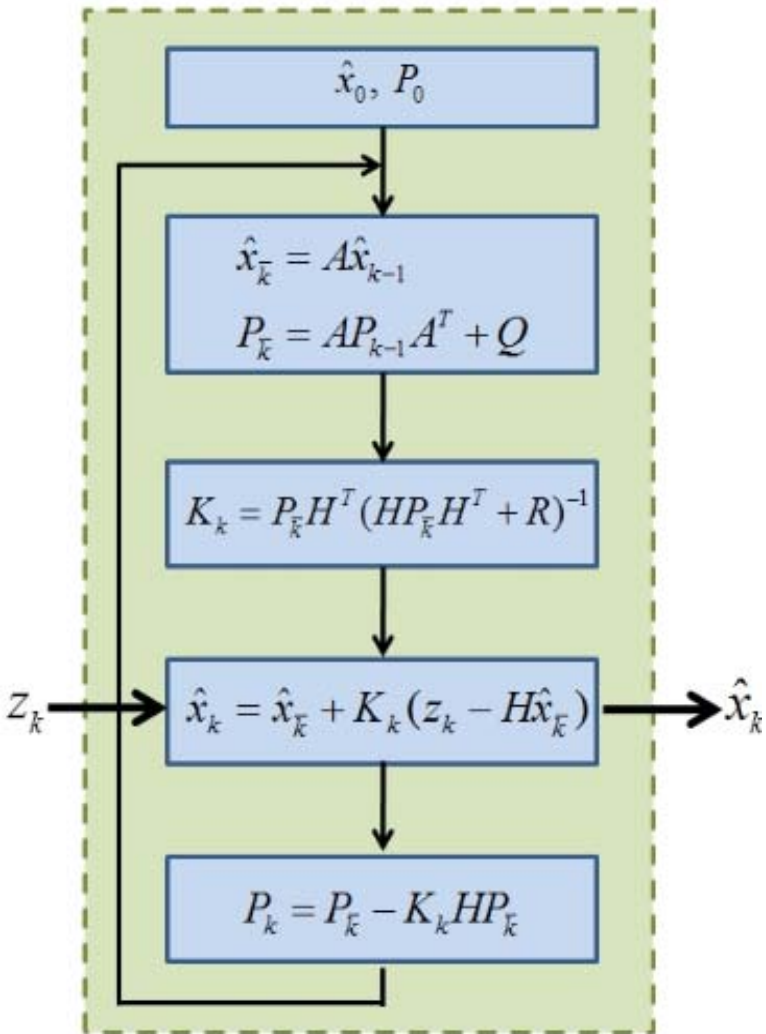
xp = A*x;
Pp = A*P*A' + Q;

K = Pp*H'*inv(H*Pp*H' + R);

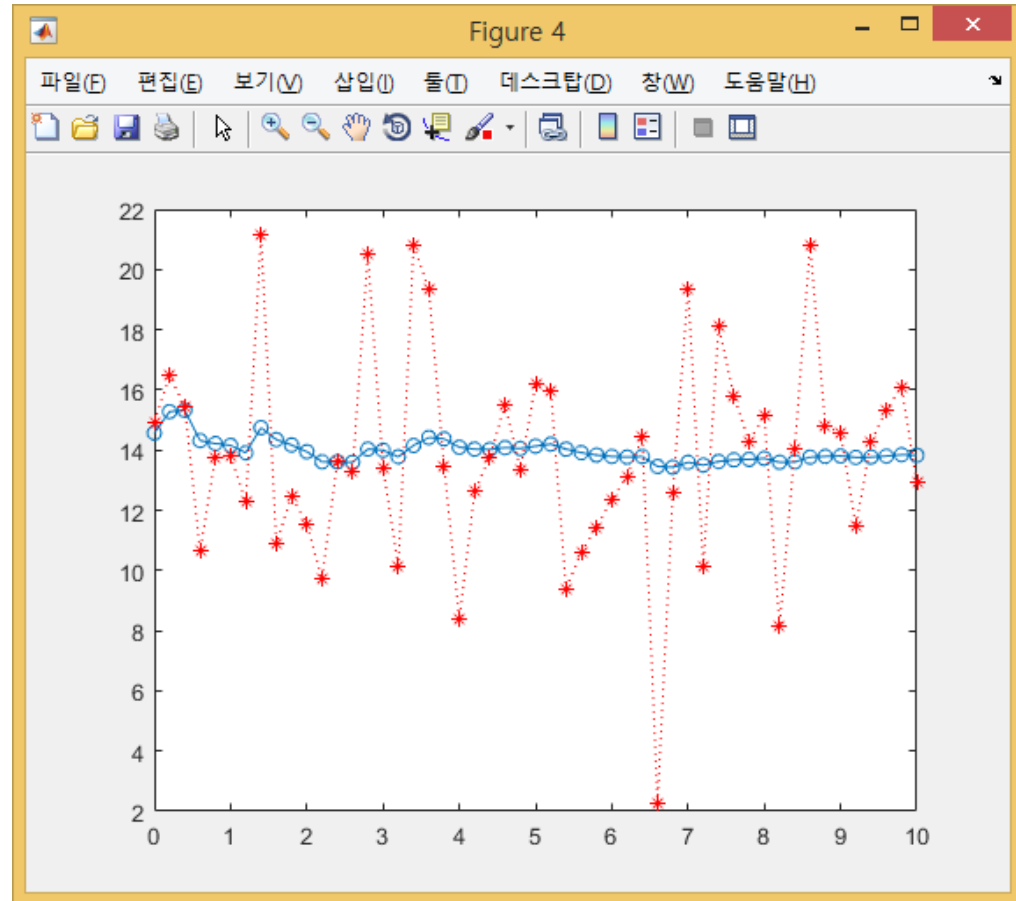
x = xp + K*(z - H*xp);
P = Pp - K*H*Pp;

volt = x;
  
```

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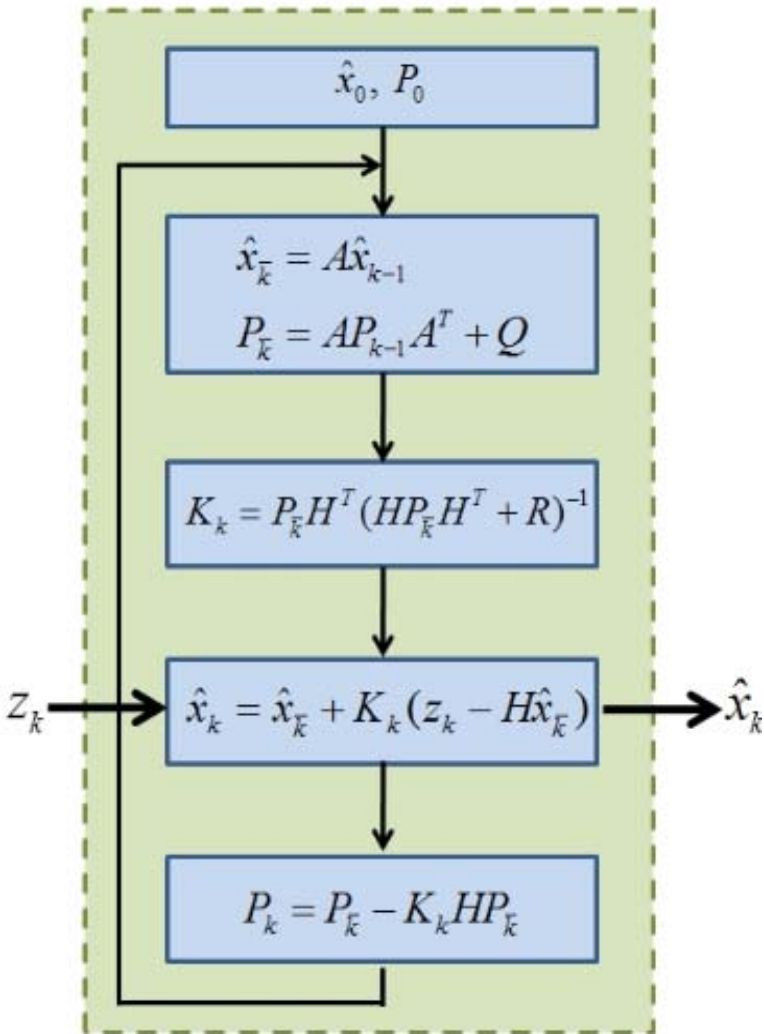


Kalman Filter algorithm





# 1. 프로그램



Kalman Filter algorithm

```
clear all

dt = 0.2;
t = 0:dt:10;

Nsamples = length(t);
Xsaved = zeros(Nsamples, 1);
Zsaved = zeros(Nsamples, 1);

for k=1:Nsamples
    z = GetVolt();
    volt = SimpleKalman(z);
    Xsaved(k) = volt;
    Zsaved(k) = z;
end

figure
plot(t, Xsaved, 'o-')
hold on
plot(t, Zsaved, 'r:*')
```