?????? (Kalman Filter) ??????

[illegible] **[illegible]** [illegible]

1. ?????????? (GPS ?? vs. ???)

[illegible]

1. [illegible] **([illegible] / [illegible])**：[illegible] 60 km/h [illegible]
2. [illegible] **GPS ([illegible])**：GPS [illegible] ± 5 [illegible]

[illegible] GPS [illegible] GPS [illegible] **GPS** [illegible] **[illegible] (Kalman Gain)** [illegible] GPS [illegible]

---

2. ????????? (Predict) ? ?? (Update)

[illegible]

1. [illegible] **(Predict)** [illegible]
   [illegible]
2. [illegible] **(Update)** [illegible]
   [illegible]

---

3. ??????? 5 ??????

[illegible]

?? ?????? (Predict)

- [illegible] **([illegible])**：$$\hat{x}_{k}^{-} = A \hat{x}_{k-1} + B u_k$$

- [illegible] ([illegible])[illegible] $$P_{k}^{-} = A P_{k-1} A^T + Q$$ *([illegible] Q [illegible])*

?? ?????? (Update)

- [illegible] ([illegible])[illegible] $$K_k = P_{k}^{-} H^T (H P_{k}^{-} H^T + R)^{-1}$$ *([illegible] R* [illegible]*)*
- [illegible] ([illegible])[illegible] $$\hat{x}*k = \hat{x}*{k}^{-} + K_k (z_k - H \hat{x}_{k}^{-})$$
- [illegible] ([illegible])[illegible] $$P_k = (I - K_k H) P_{k}^{-}$$

---

4. MATLAB 1D ????????????

[illegible] 1D [illegible] 1.2V [illegible]

```
% 1. [illegible]
N = 100;                % [illegible] 100 [illegible]
true_voltage = 1.2;     % [illegible] ([illegible])
measured_v = true_voltage + 0.1 * randn(1, N); % [illegible]

% 2. [illegible]
x_est = 0;              % [illegible] ([illegible] 0)
P = 1;                  % [illegible] ([illegible] 1 [illegible])

% [illegible]Q [illegible] R
Q = 1e-5;               % [illegible] ([illegible])
R = 0.01;               % [illegible] ([illegible] 0.1^2)

% [illegible]
kalman_result = zeros(1, N);

% 3. [illegible] (Predict -> Update)
for k = 1:N

    % --- [[illegible] Predict] ---
    % [illegible] A=1, B=0
    x_pred = x_est;             % [illegible]
    P_pred = P + Q;             % [illegible]
```

```
    % --- [□□□□ Update] ---
    % □□□□□□□□ z_k
    z_k = measured_v(k);

    % □□□□□□□ (H=1)
    K = P_pred / (P_pred + R);

    % □□□□□□□□
    x_est = x_pred + K * (z_k - x_pred);

    % □□□□□□
    P = (1 - K) * P_pred;

    % □□□□□□□
    kalman_result(k) = x_est;
end

% 4. □□□□
figure;
hold on;
plot(1:N, true_voltage * ones(1,N), 'g-', 'LineWidth', 2); % □□□ (□□)
plot(1:N, measured_v, 'r.', 'MarkerSize', 10);             % □□□ (□□)
plot(1:N, kalman_result, 'b-', 'LineWidth', 2);            % □□□□□□□ (□□)
hold off;

title('□□□□□□ 1D □□□□□□');
xlabel('□□□□');
ylabel('□□ (V)');
legend('□□□', '□□□□□□ (□□□)', '□□□□□□□□□□□');
grid on;
```

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