Z_i
X_i
X_i
Z_i
X_i
$5\times$
1
$C(u_c, v_c)$
$w\times$
h
s
Z_i
X_i
$Z =$
$[x_z, z_z, h_z]$
(x_z, z_z)
h_z
$\hat{Z}$
??

$$Z = \begin{bmatrix} R(\phi_\theta) & 0 \\ 0 & 1 \end{bmatrix} \hat{Z} + \begin{bmatrix} x_\theta \\ z_\theta \end{bmatrix} \quad (1)$$

$R(\phi_\theta)$
$2\times$
2
h
ϕ_θ
x_θ
z_θ
$3\times$
1
$Ce_\theta =$
$\{\phi_\theta, x_\theta, z_\theta\}$
h_θ
r_θ
Z

$$X = f_P(Z, \Theta) == \begin{bmatrix} u_X \\ v_X \\ h_X \end{bmatrix} = \begin{bmatrix} \frac{f_\theta x_z}{z_z} + u_\theta \\ \frac{f_\theta h_\theta}{z_z} + v_\theta \\ \frac{f_\theta h_z}{z_z} \end{bmatrix} \quad (2)$$

(u_X, v_X)
h_X
f_θ
u_θ
v_θ
$4\times$
1
$Ci_\theta =$
$\{f_\theta, u_\theta, v_\theta, h_\theta\}$

$$\hat{Z} = f_P^{-1}(X, \Theta) = \begin{bmatrix} \frac{h_\theta(u_x - u_\theta)}{v_x - v_\theta} \\ \frac{f_\theta h_\theta}{v_x - v_\theta} \\ \frac{h_\theta h_z}{v_x - v_\theta} \end{bmatrix} \quad (3)$$

$8\times$
1
$\Theta =$
$\{Ci_\theta, Ce_\theta, r_\theta\}$
n
$G_{i,t}$
$\tau_{i,t}$
t
$\hat{\tau_{i,t}}$
$G_{i,t}$
$G_{i,t}$
t
$G_{i,t}$
(x, z)
α
$\tau_{i,t}$
u, v
f_P^{-1}
f_P
$\tau_{t-1,i}$
Θ_{t-1}
Θ_t
$\hat{\tau_{t,i}}$
$\hat{\tau_{t,i}}$
$\tau_{t,i}$

n
$(\tau_t, \tau_{t-1})_i, i =$
$1..n$
$I_t, t =$
0
t
$t-$
1
$\hat{G_{t,i}}$
$\tau_{t,i}$

Target state
$Z^t = \{Z_{t,i}\}_{i=1}^{N_Z}$
t
i
t
$Z_{i,t} = [x, z, v_x, v_z, h, c]$
(x, z)
(v_x, v_z)
h
c
Camera state
Θ^t
t
8×1
$\Theta_t = \{\phi_\theta, x_\theta, z_\theta f_\theta, u_\theta, v_\theta, h_\theta, r_\theta\}$
ϕ_θ
x_θ
z_θ
f_θ
u_θ
v_θ
Ground feature state
$G^t = \{G_{t,k}\}_{k=1}^{M_G}$
??
3×1
(x, z)
α
$\Omega^t = [Z_t, \Theta_t, G_t]$
Target observation
$X^t = \{X_{t,j}\}_{j=1}^{N_C}$
N_C
$C = 1..Nclasses$
t
5×1
$X_{t,j} = [u_c, v_c, w, p_{obj}]$
(u_c, v_c)
(w, h)
p_{obj}
C
Target observation
$Y^t = \{Y_{t,i}\}_{h=1}^{N}$
t
5×1
$Y_{t,i} = [u_c, v_c, w, s]$
(u_c, v_c)
(w, h)
s
Ground feature observation
$\tau_{t,k}$
$\tau_{k,t}$
(u, v)
$G_{t,k}$
$\chi^t = [X^t, Y^t, \tau^t]$
Ω^t
χ^t
$p(\Omega^t|\chi^{t-1})$
$p(\Omega^t|\chi^t)$
t
??
χ^t
Ω^t
$P(\Omega^t|\chi^t)$

$$\int$$