Quadrotor

Dynamics equation:

$$\ddot{x} = -\frac{f_t}{m}[\sin\phi \sin\psi + \cos\phi \cos\psi \sin\theta] \tag{1}$$
$$\ddot{y} = -\frac{f_t}{m}[\cos\phi \sin\psi \sin\theta + \cos\psi \sin\phi] \tag{2}$$
$$\ddot{z} = g - \frac{f_t}{m}[\cos\phi \cos\theta] \tag{3}$$
$$\ddot{\phi} = \frac{I_y - I_z}{I_x}\dot{\theta}\dot{\psi} + \frac{\tau_x}{I_x} \tag{4}$$
$$\ddot{\theta} = \frac{I_z - I_x}{I_y}\dot{phi}\dot{\psi} + \frac{\tau_y}{I_y} \tag{5}$$
$$\ddot{\psi} = \frac{I_x - I_y}{I_z}\dot{\phi}\dot{\theta} + \frac{\tau_z}{I_z} \tag{6}$$

where

x, y, z are linear coordinates in reference frame (z is a vertical coordinate)
ϕ, θ, ψ are rp;;, pitch and yaw angles
f_t is a thrust
τ_x, τ_y and τ_z are force momentums
m is a quadrotor mass
g is a free fall acceleration
I_x, I_y, I_z are inertia momentums along respective axis of quadrotor
l is the distance between any rotor and the center of the quadrotor
b is the thrust coefficient
d is the drag factor
Dependence between forces and velocities:

$$f_t = b(\Omega_1^2 + \Omega_2^2 + \Omega_3^2 + \Omega_4^2) \tag{7}$$
$$\tau_x = bl(\Omega_3^2 - \Omega_1^2) \tag{8}$$
$$\tau_y = bl(\Omega_4^2 - \Omega_2^2) \tag{9}$$
$$\tau_z = d(\Omega_1^2 + \Omega_4^2 - \Omega_1^2 - \Omega_3^2) \tag{10}$$

where Ω is a velocity

$$\Omega_1 = \sqrt{\frac{f_t - \frac{b}{d}\tau_z - \frac{2}{l}\tau_x}{4b}} \tag{11}$$
$$\Omega_2 = \sqrt{\frac{f_t + \frac{b}{d}\tau_z - \frac{2}{l}\tau_y}{4b}} \tag{12}$$
$$\Omega_3 = \sqrt{\frac{f_t - \frac{b}{d}\tau_z + \frac{2}{l}\tau_x}{4b}} \tag{13}$$
$$\Omega_4 = \sqrt{\frac{f_t + \frac{b}{d}\tau_z + \frac{2}{l}\tau_y}{4b}} \tag{14}$$