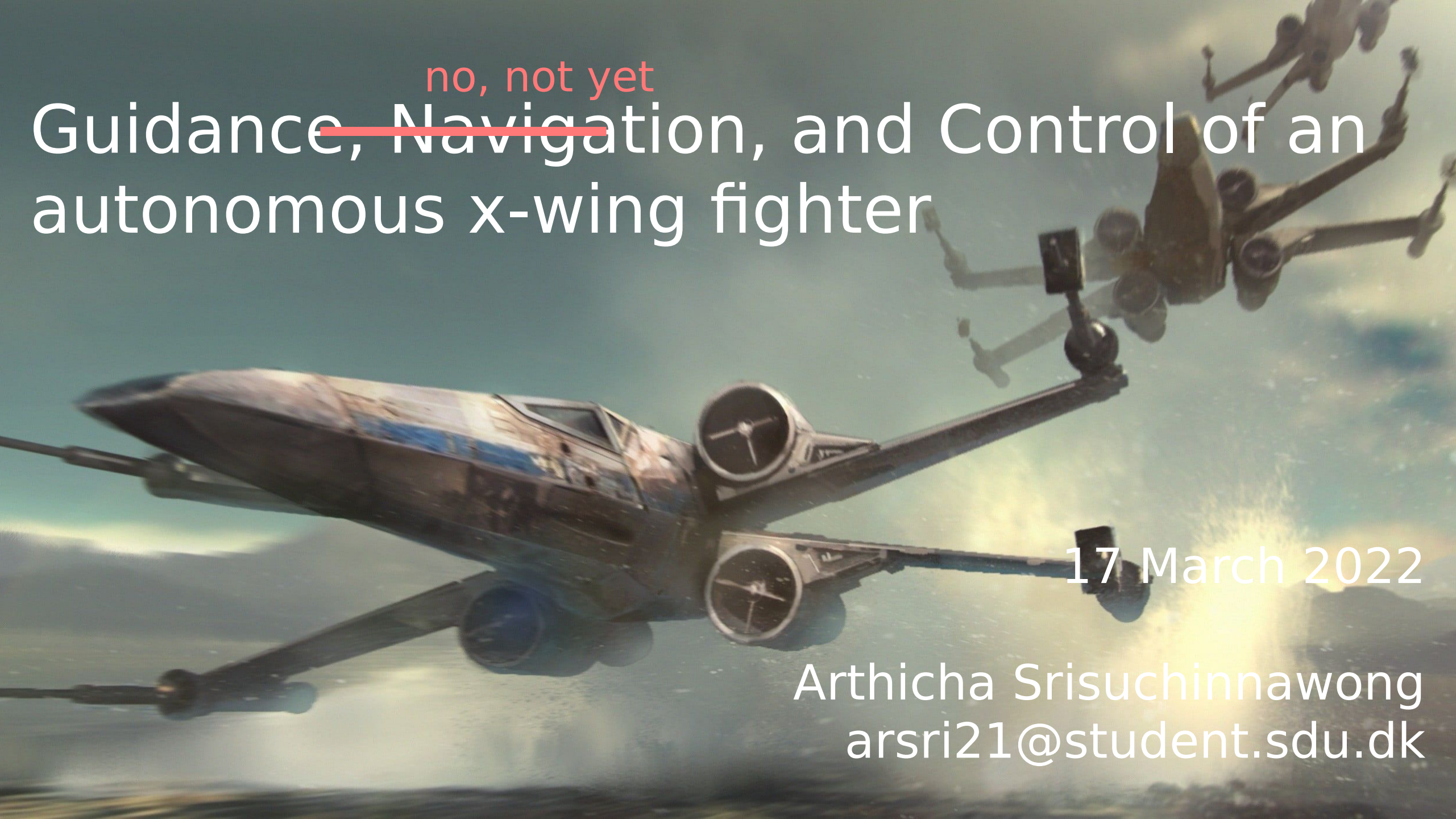
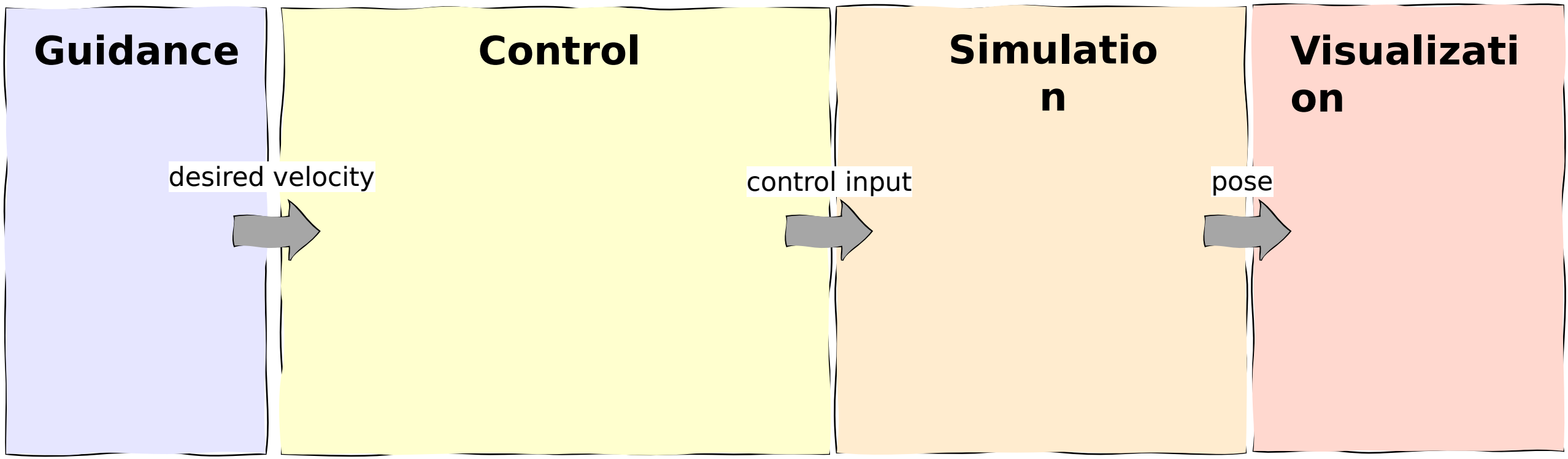
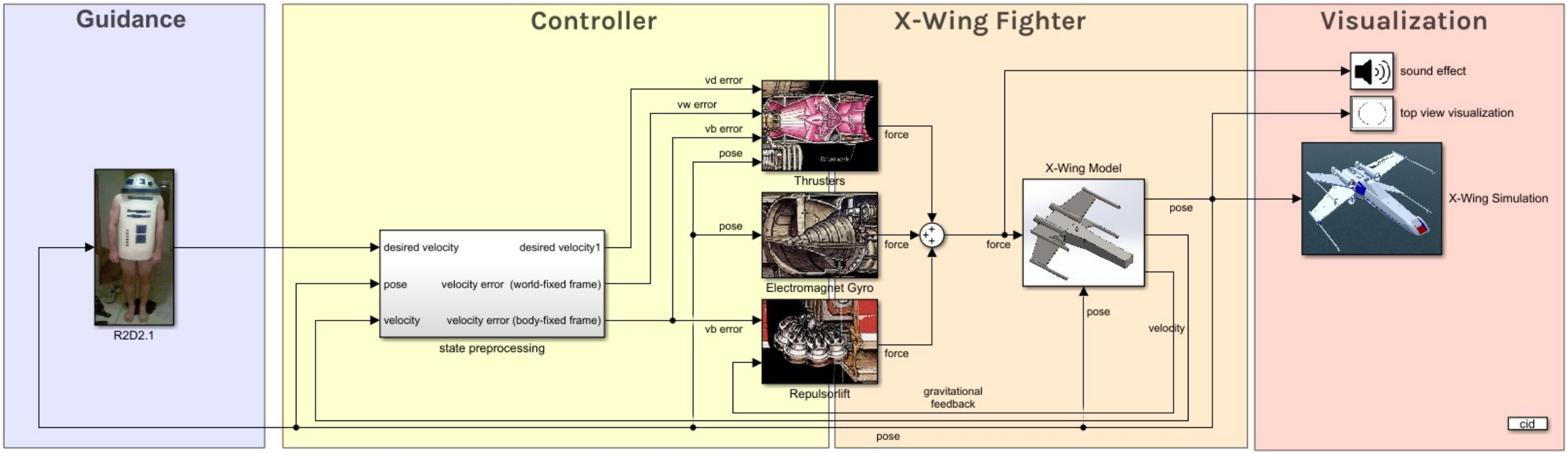

no, not yet
Guidance, Navigation, and Control of an autonomous x-wing fighter
17 March 2022
Arthicha Srisuchinnawong
arsri21@student.sdu.dk

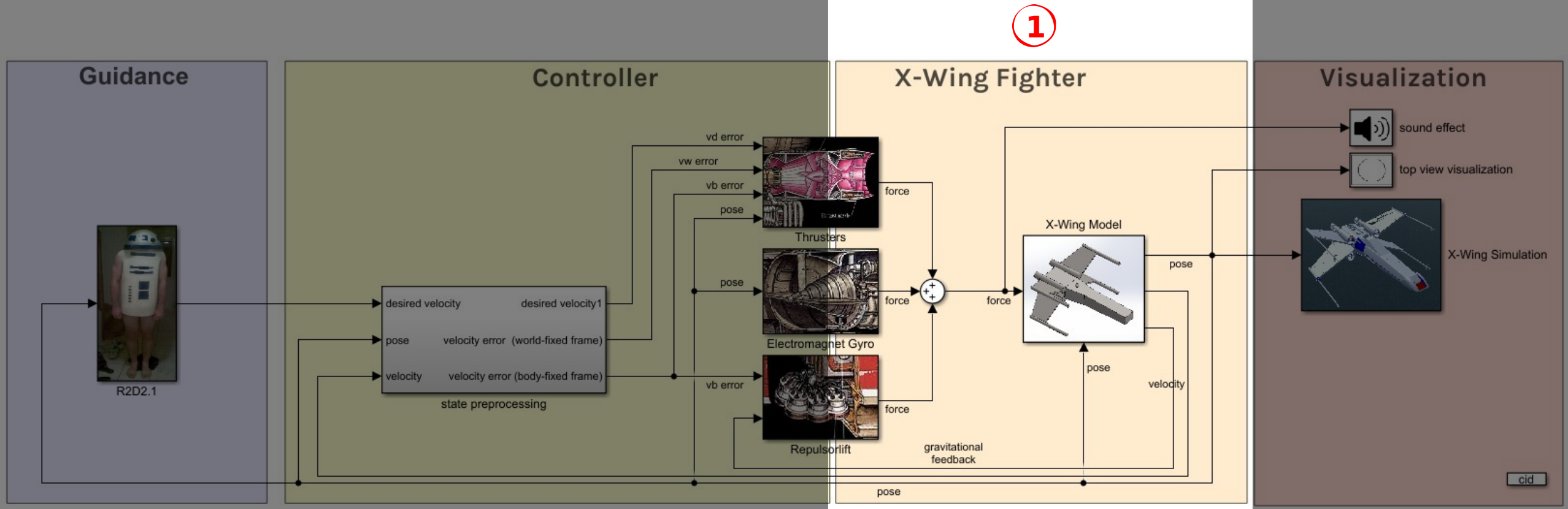
Overview


Guidance
Control
Simulation
Visualization
desired velocity
control input
pose

Overview


Guidance
R2D2.1
Controller
desired velocity
desired velocity1
pose
velocity error (world-fixed frame)
velocity
velocity error (body-fixed frame)
state preprocessing
vd error
vw error
vb error
pose
Thrusters
force
pose
Electromagnet Gyro
force
vb error
Repulsorlift
force
X-Wing Fighter
force
X-Wing Model
pose
pose
velocity
gravitational feedback
pose
Visualization
sound effect
top view visualization
X-Wing Simulation
cid

Overview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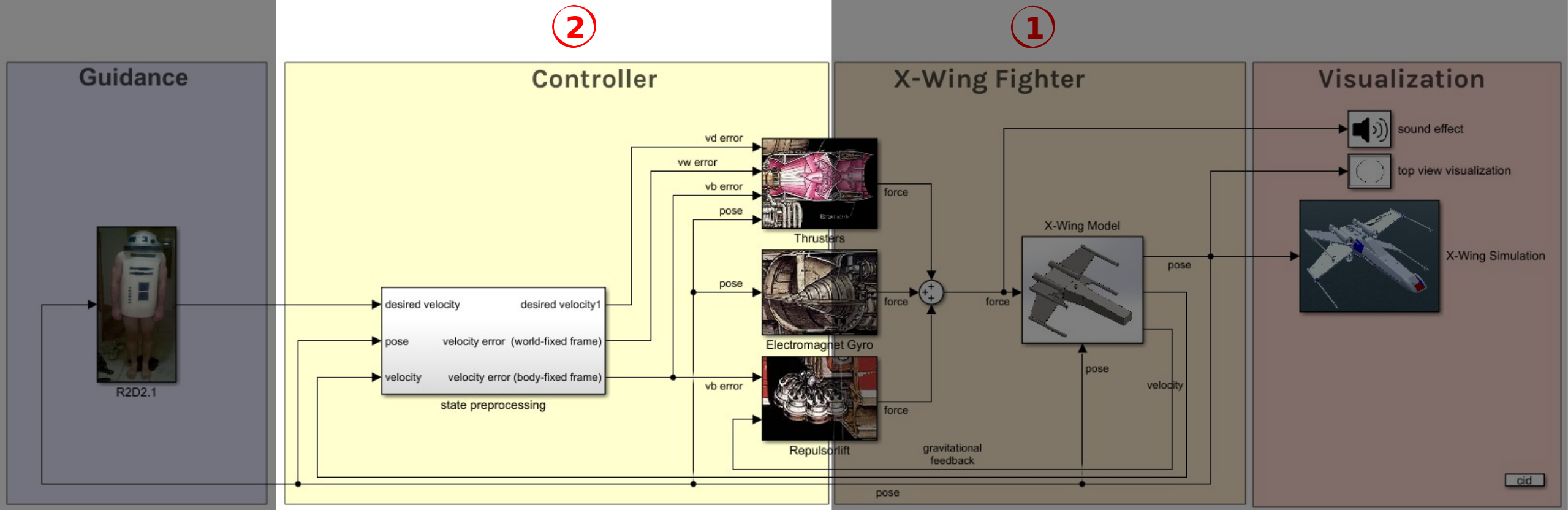
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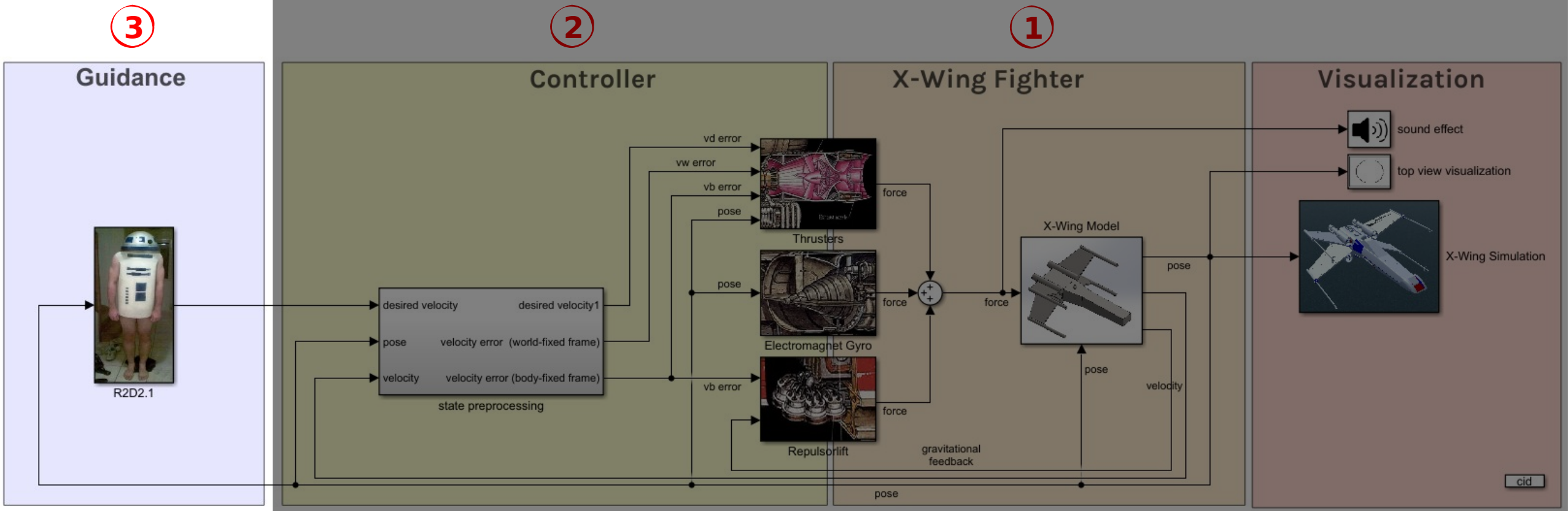
3
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1
Guidance
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X-Wing Fighter
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R2D2.1
desired velocity
desired velocity1
pose
velocity error (world-fixed frame)
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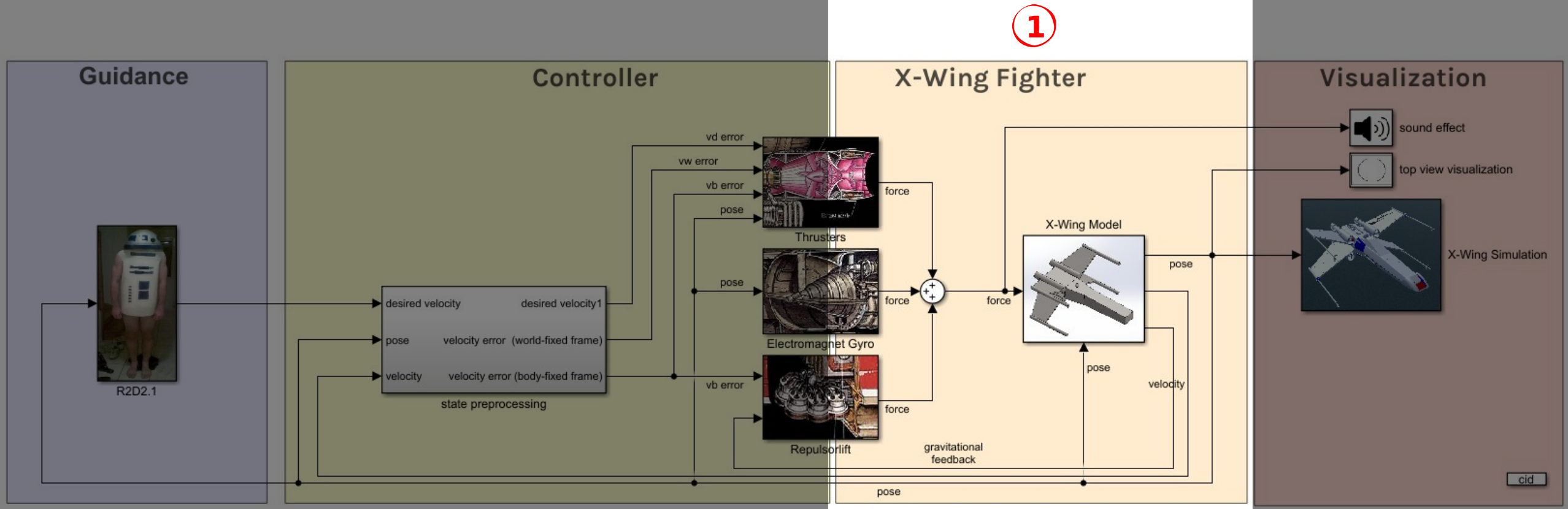
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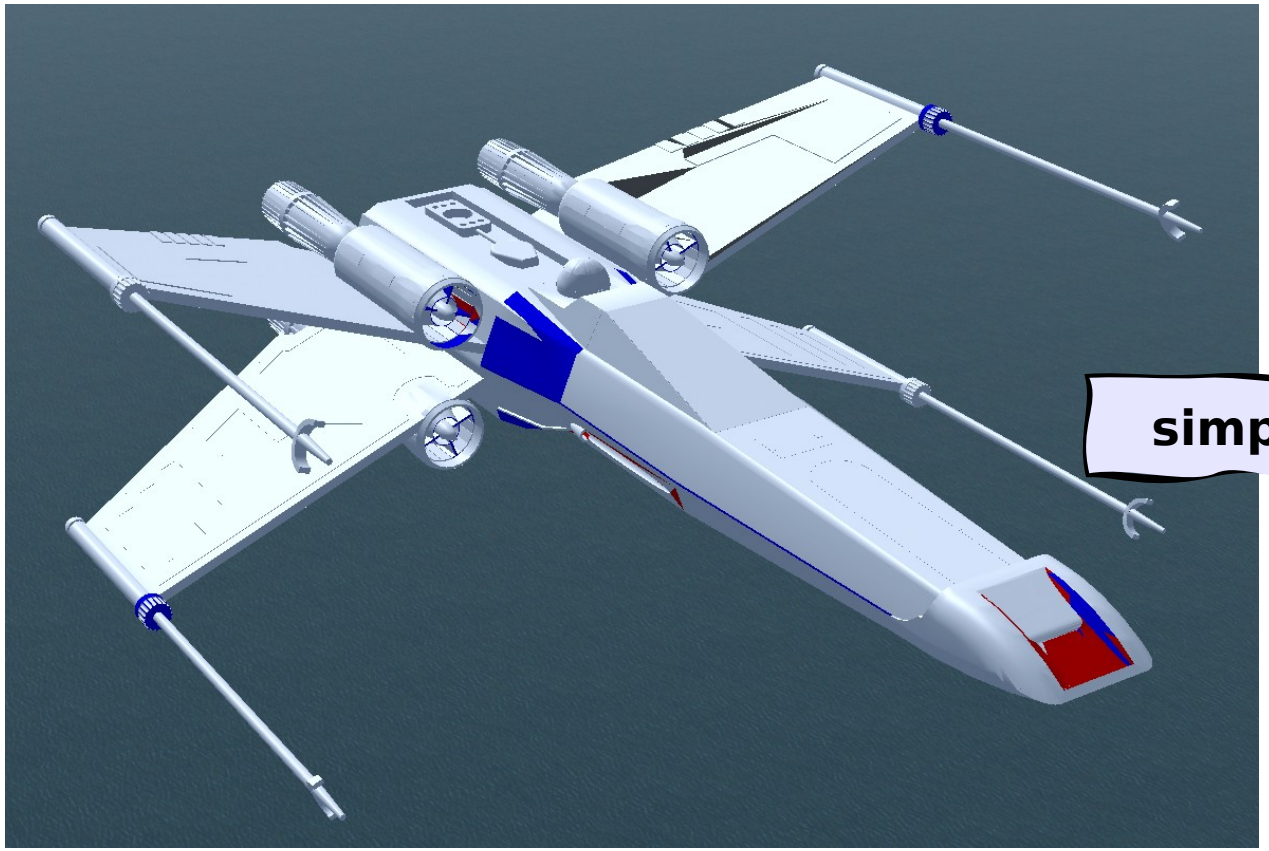
cid

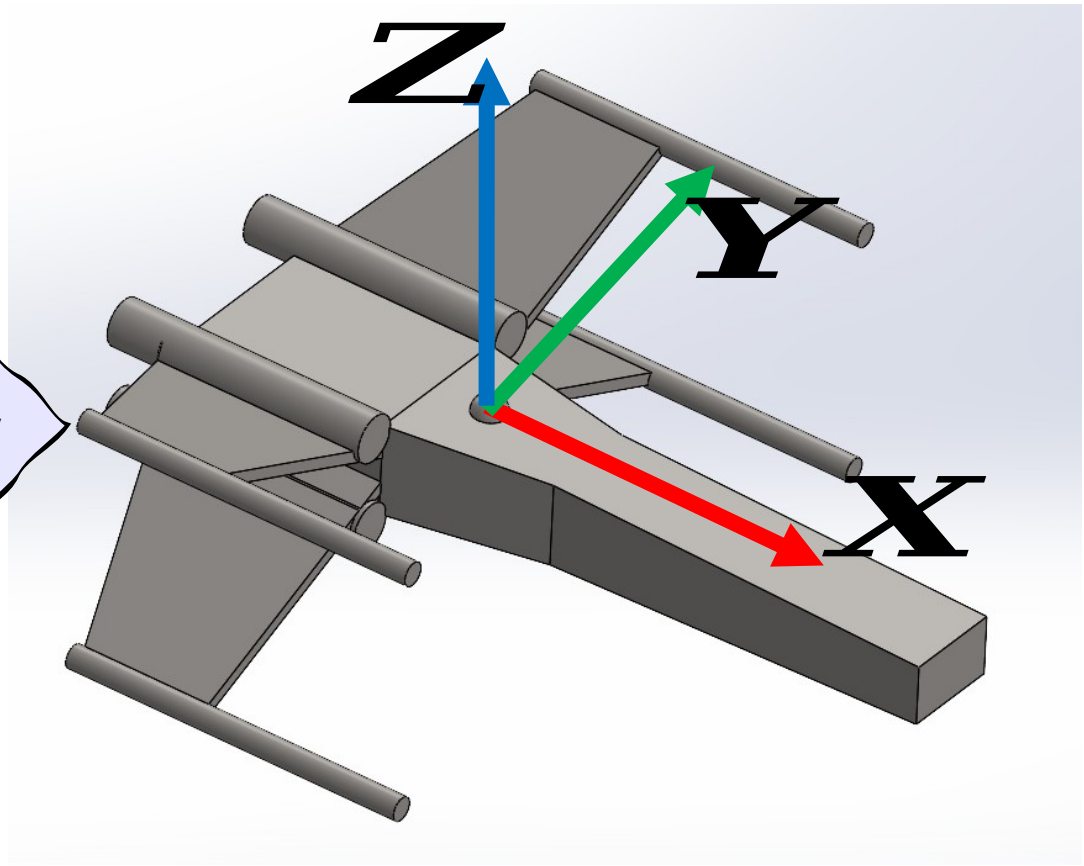
Model

X-Wing Fighter

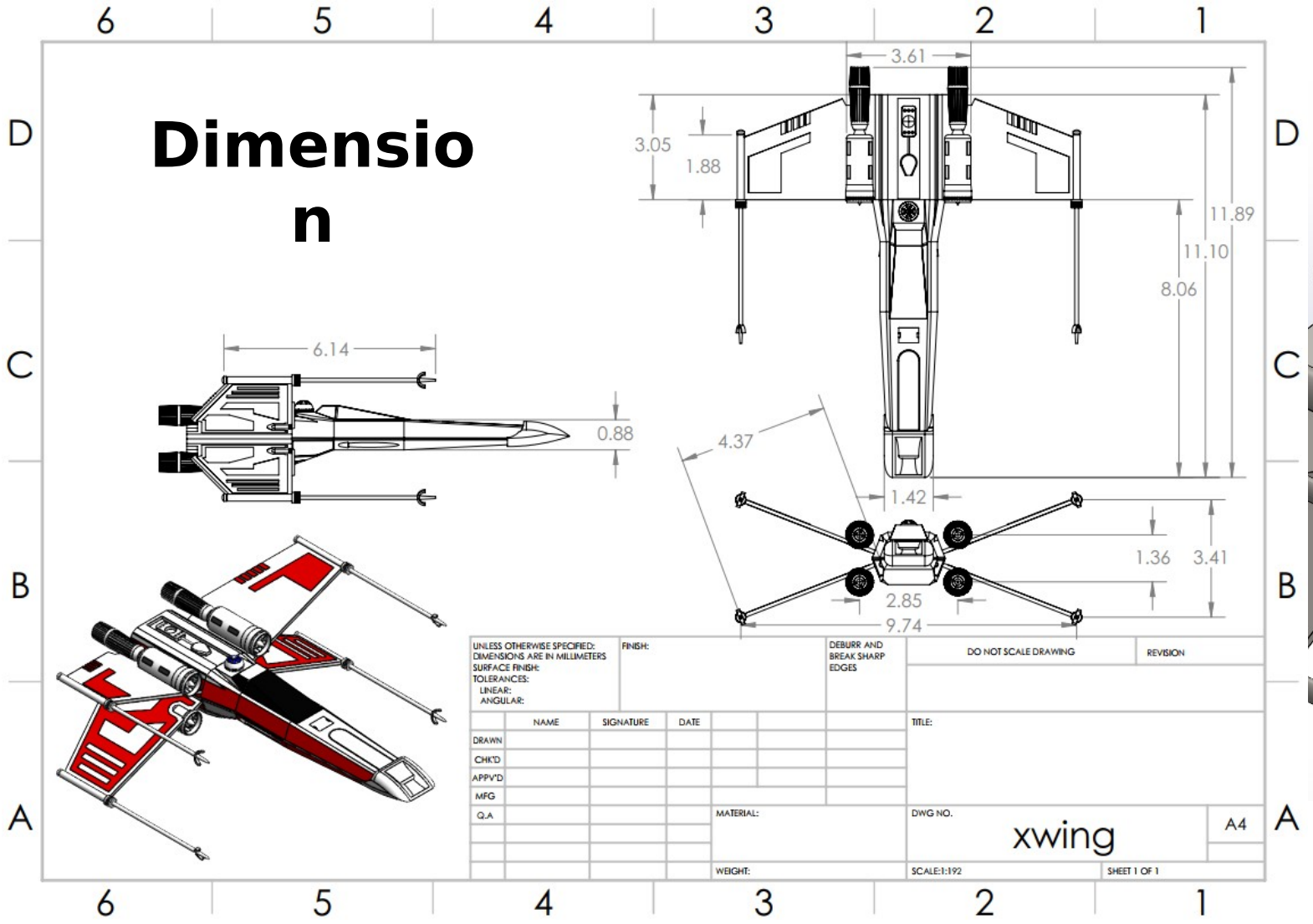


simplify

Model



Model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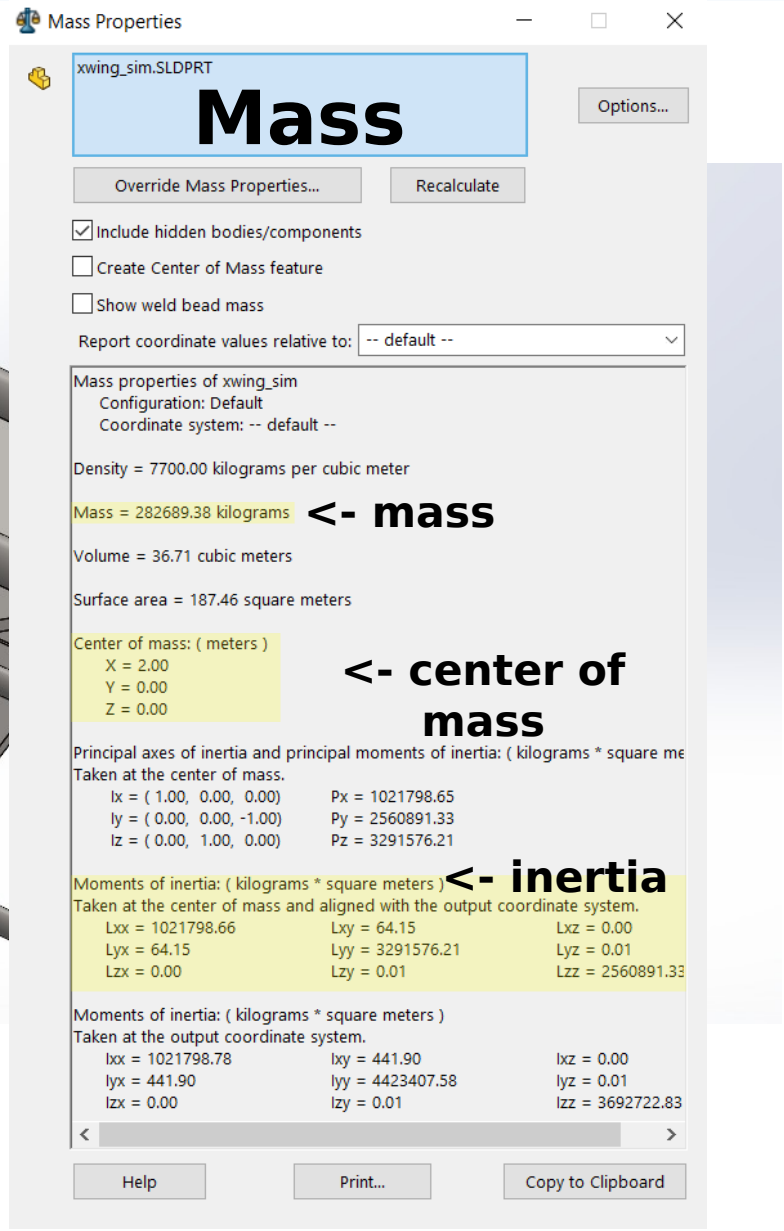
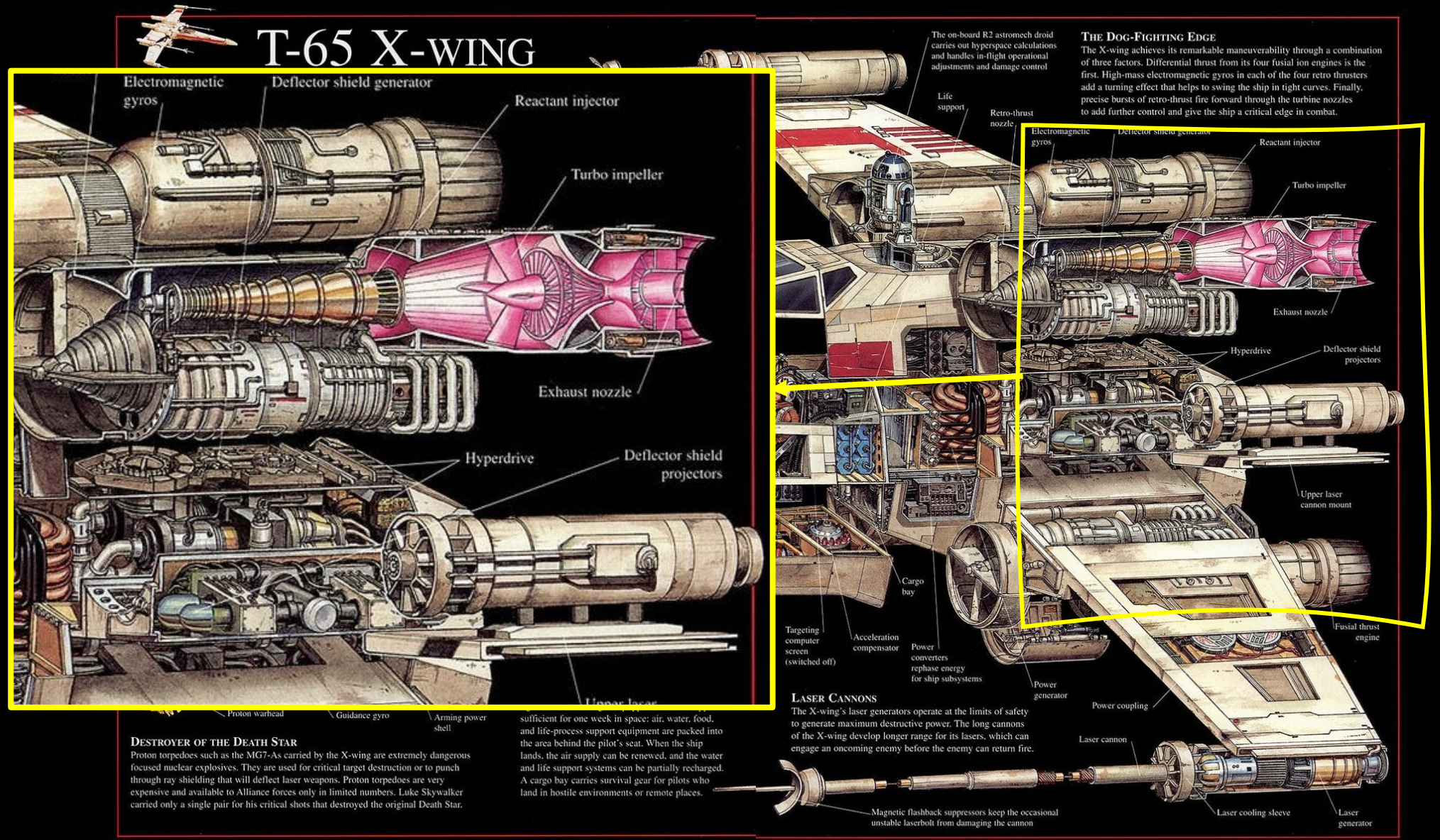
6 5 4 3 2 1
D
C
B
A
3.61
3.05
1.88
11.89
11.10
8.06
6.14
0.88
4.37
1.42
1.36
3.41
2.85
9.74
UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN MILLIMETERS
SURFACE FINISH:
TOLERANCES:
LINEAR:
ANGULAR:
FINISH:
DEBURR AND BREAK SHARP EDGES
DO NOT SCALE DRAWING
REVISION
NAME
SIGNATURE
DATE
DRAWN
CHK'D
APPV'D
MFG
Q.A
TITLE:
MATERIAL:
DWG NO.
xwing
A4
WEIGHT:
SCALE:1:192
SHEET 1 OF 1


Mass Properties
xwing_sim.SLDPRT
Mass
Options...
Override Mass Properties...
Recalculate
Include hidden bodies/components
Create Center of Mass feature
Show weld bead mass
Report coordinate values relative to: -- default --
Mass properties of xwing_sim
Configuration: Default
Coordinate system: -- default --
Density = 7700.00 kilograms per cubic meter
Mass = 282689.38 kilograms
<- mass
Volume = 36.71 cubic meters
Surface area = 187.46 square meters
Center of mass: (meters)
X = 2.00
Y = 0.00
Z = 0.00
<- center of mass
Principal axes of inertia and principal moments of inertia: (kilograms * square me
Taken at the center of mass.
Ix = (1.00, 0.00, 0.00) Px = 1021798.65
Iy = (0.00, 0.00, -1.00) Py = 2560891.33
Iz = (0.00, 1.00, 0.00) Pz = 3291576.21
Moments of inertia: (kilograms * square meters)
<- inertia
Taken at the center of mass and aligned with the output coordinate system.
Lxx = 1021798.66 Lxy = 64.15 Lxz = 0.00
Lyx = 64.15 Lyy = 3291576.21 Lyz = 0.01
Lzx = 0.00 Lzy = 0.01 Lzz = 2560891.33
Moments of inertia: (kilograms * square meters)
Taken at the output coordinate system.
Ixx = 1021798.78 Ixy = 441.90 Ixz = 0.00
Iyx = 441.90 Iyy = 4423407.58 Iyz = 0.01
Izx = 0.00 Izy = 0.01 Izz = 3692722.83
Help
Print...
Copy to Clipboard

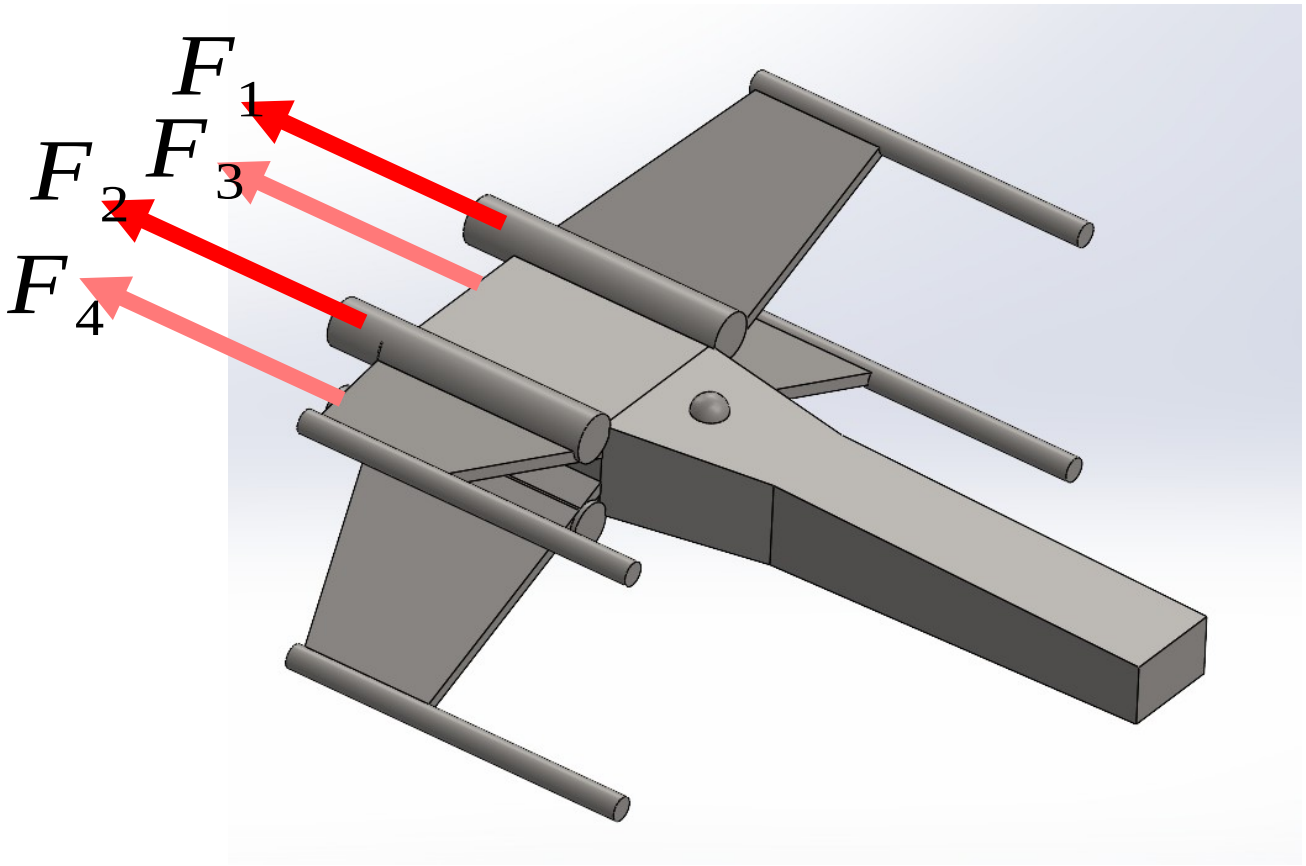
X-Wing Fighter Model: Upward



X-Wing Fighter Model: Forward

Differential Thrusters!!

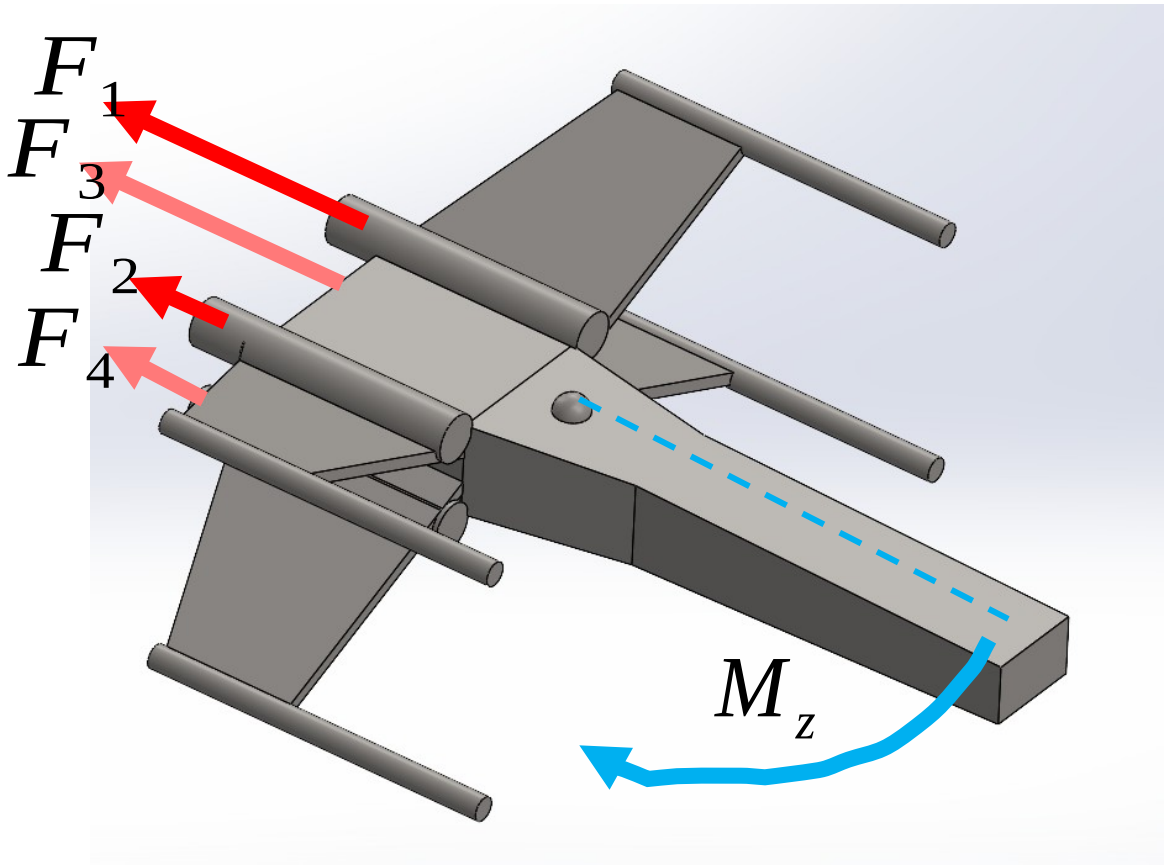
Model



X-Wing Fighter Model: Yaw

Differential Thrusters!!

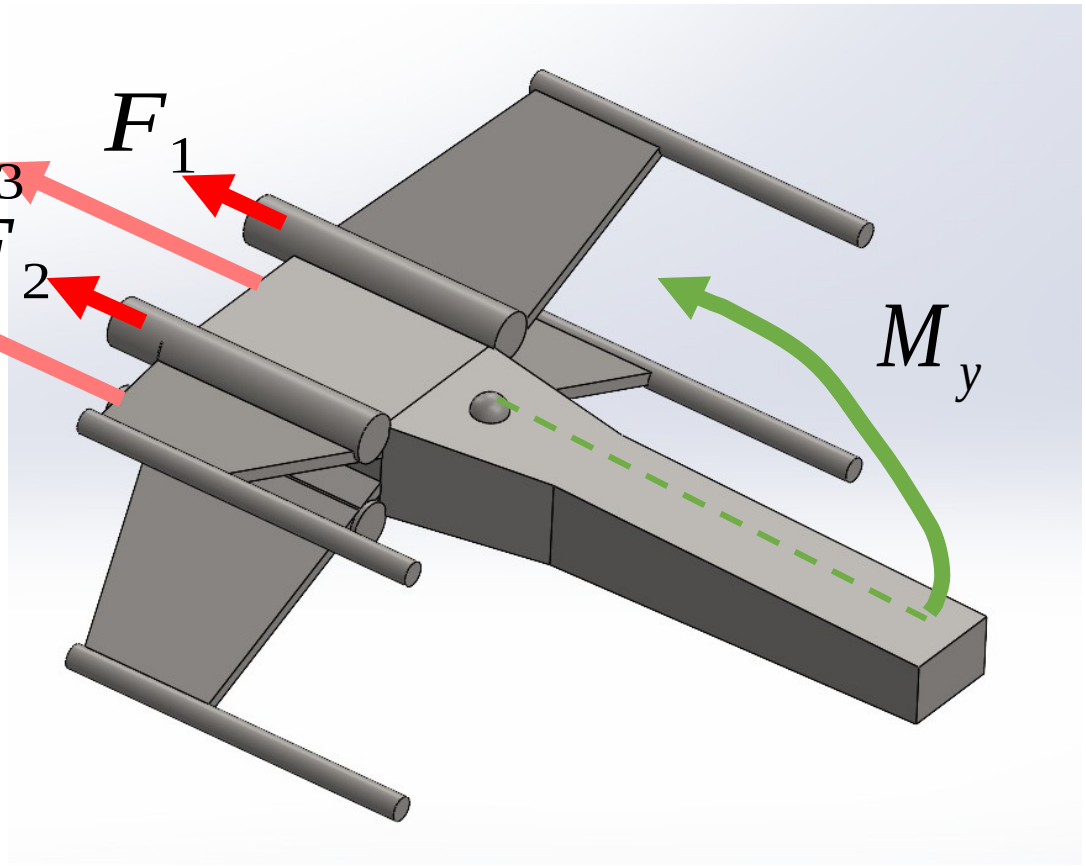
Model



X-Wing Fighter Model: Pitch

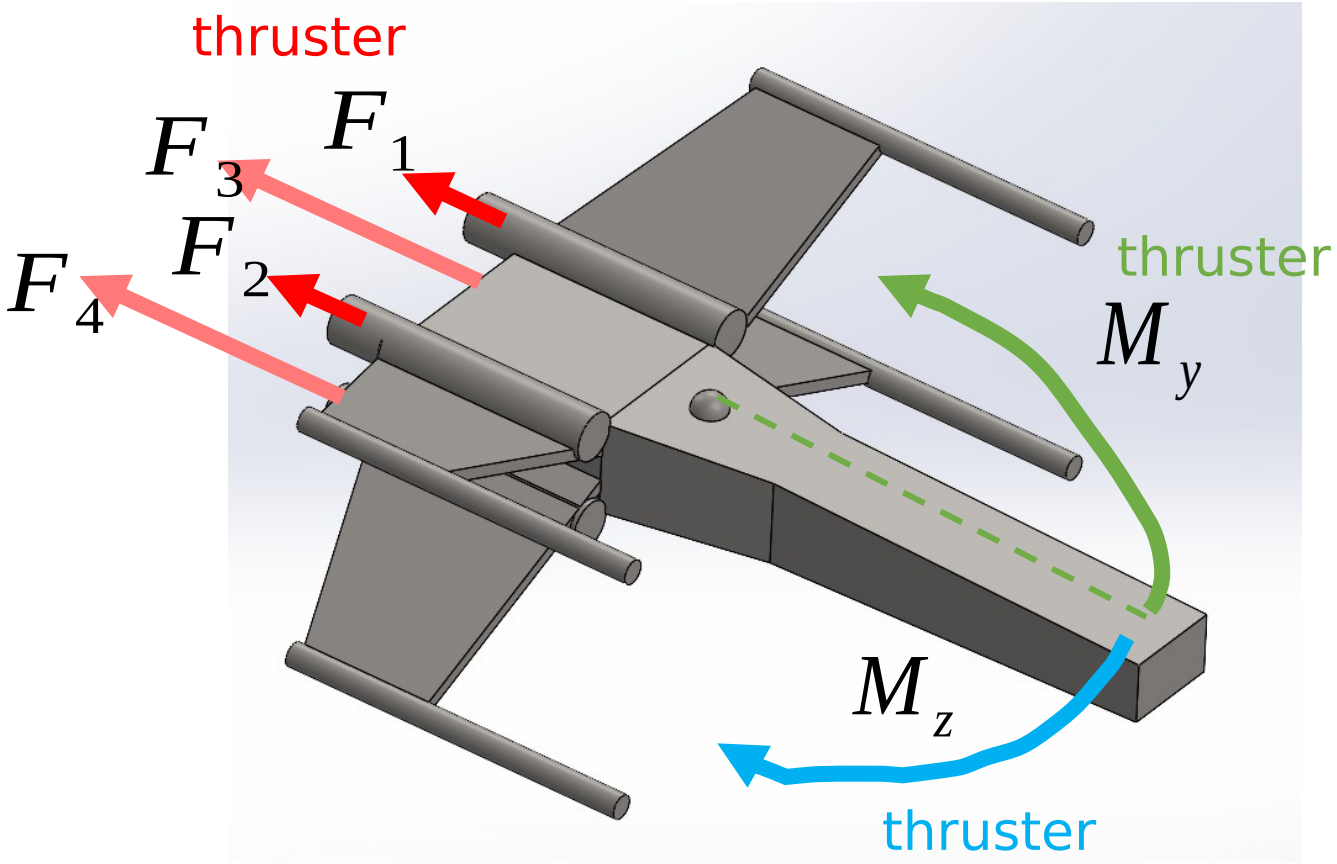
Differential Thrusters!!

Model



X-Wing Fighter Model

Model

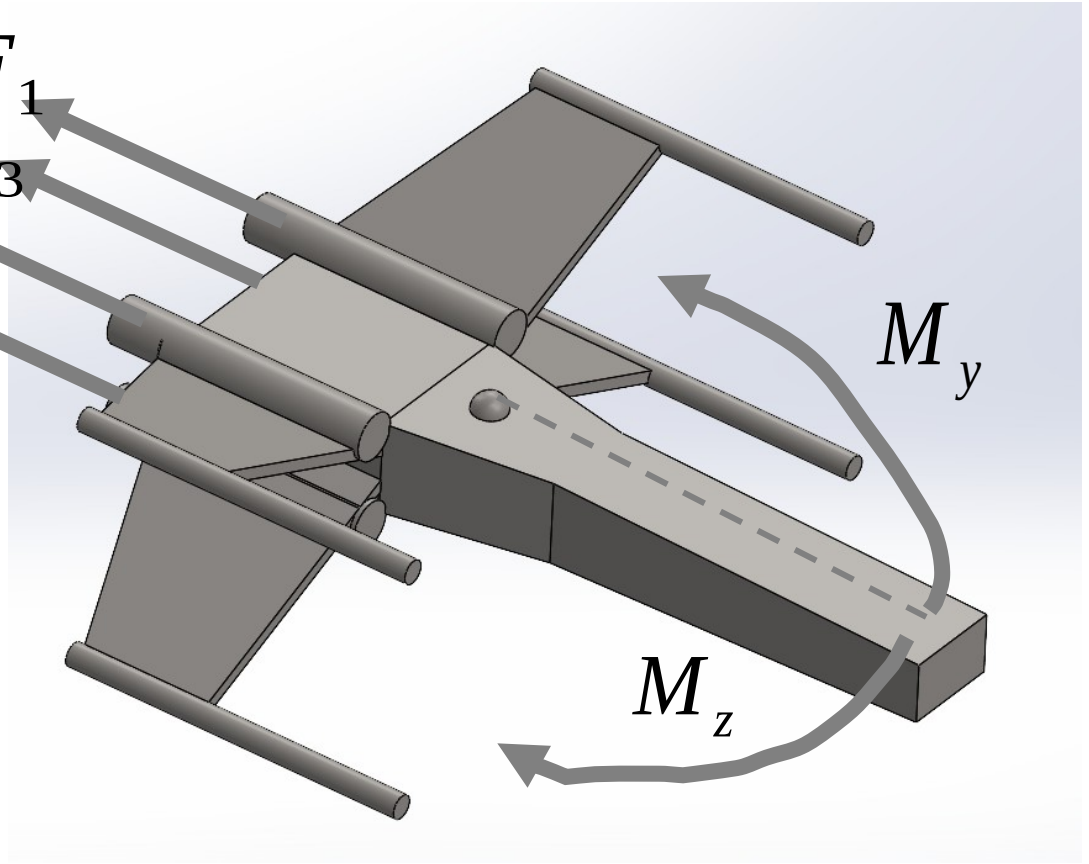


X-Wing Fighter Model: Upward

Take off ??


from star wars: a new hope

Model



X-Wing Fighter Model: Upward

Take off ??

4

Posted by u/Scarhead1342 4 years ago

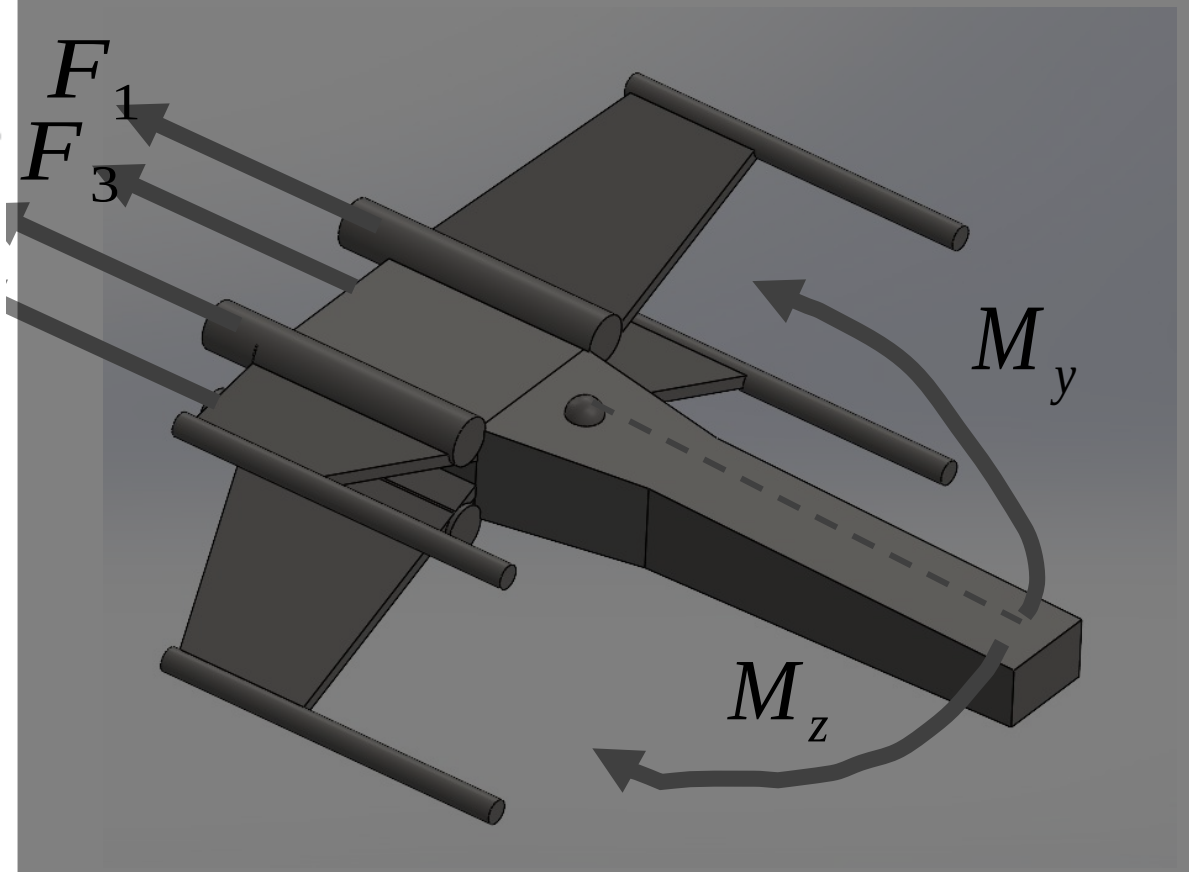
I'd like to know how the X-Wing takes off vertically.

Other

The X-Wing is shown to have horizontally mounted engines, yet it's also shown taking off vertically. I've done some poking around and haven't found anything. Thought I'd ask you guys.

9 Comments Share Save Hide Report 83% Upvoted

Model



X-Wing Fighter Model: Upward

Take off ??

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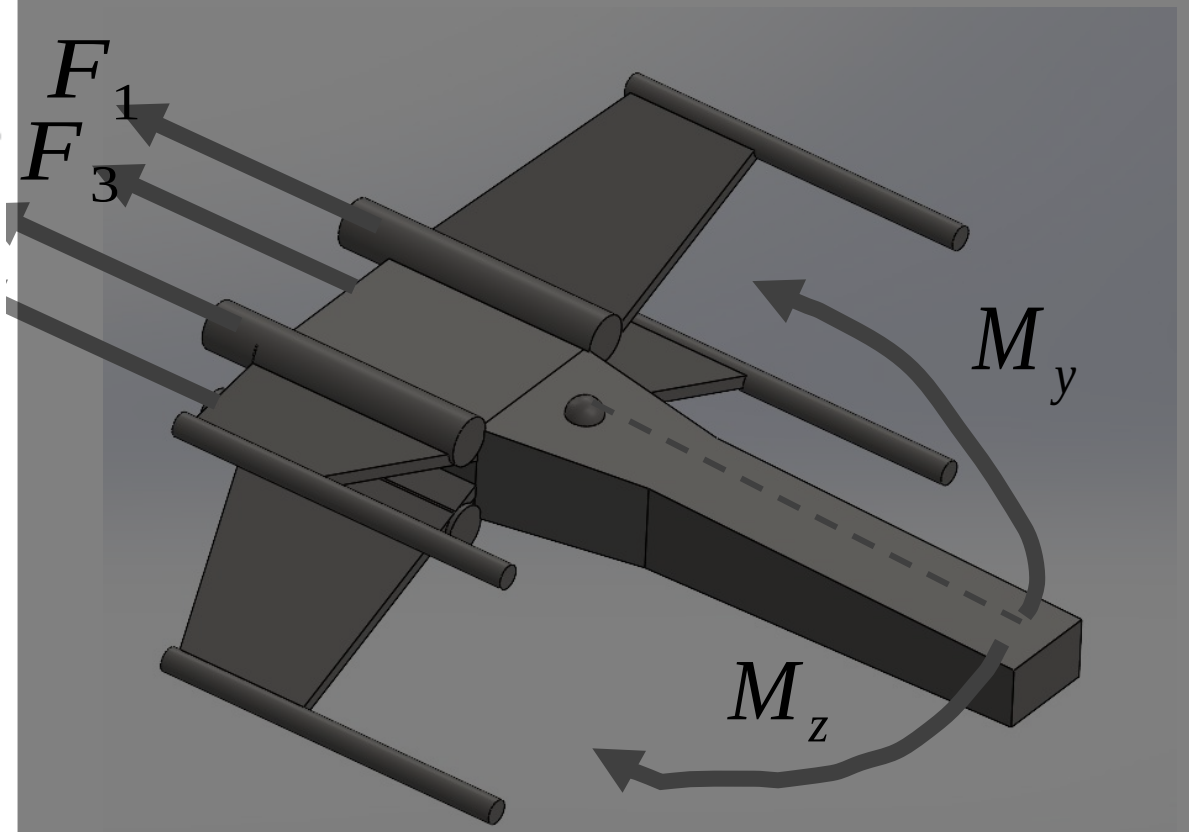
9 Comments Share Save Hide Report 83% Upvoted

xI7s · 4 yr. ago

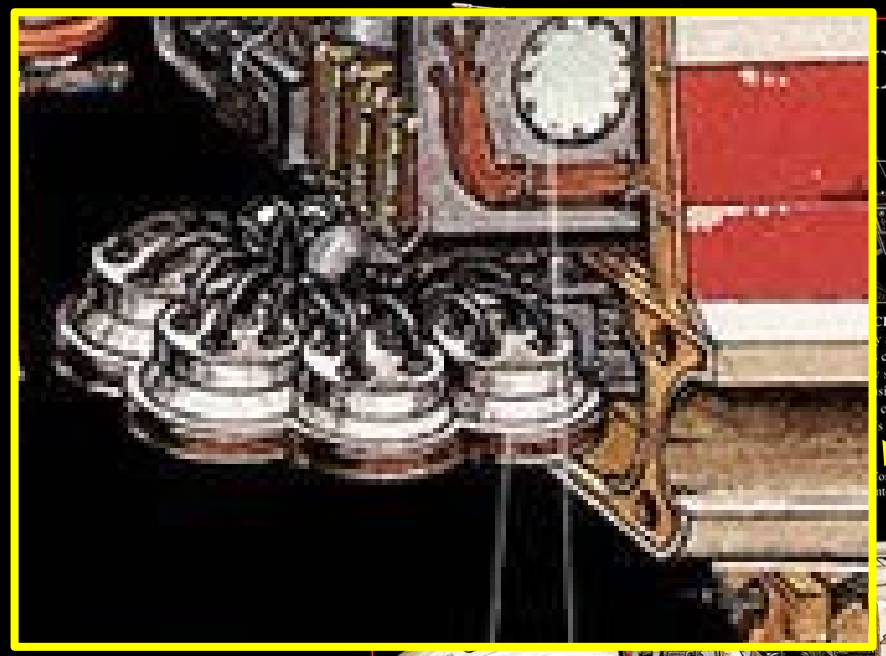
repulsorlift

14 Reply Share Report Save Follow

Model



X-Wing Fighter Model: Upward



The Dog-Fighting Edge

The X-wing achieves its remarkable maneuverabi
of three factors. Differential thrust from its four f
first. High-mass electromagnetic gyros in each of
add a turning effect that helps to swing the ship i
precise bursts of retro-thrust fire forward through
to add further control and give the ship a critical

Independent Operation

Hyperdrive and the ability to launch and land without special support enable the X-wing to operate independently, unlike Imperial TIE fighters. The X-wing is equipped with life support sufficient for one week in space: air, water, food, and life-process support equipment are packed into the area behind the pilot's seat. When the ship lands, the air supply can be renewed, and the water and life support systems can be partially recharged. A cargo bay carries survival gear for pilots who land in hostile environments or remote places.

Laser Cannons

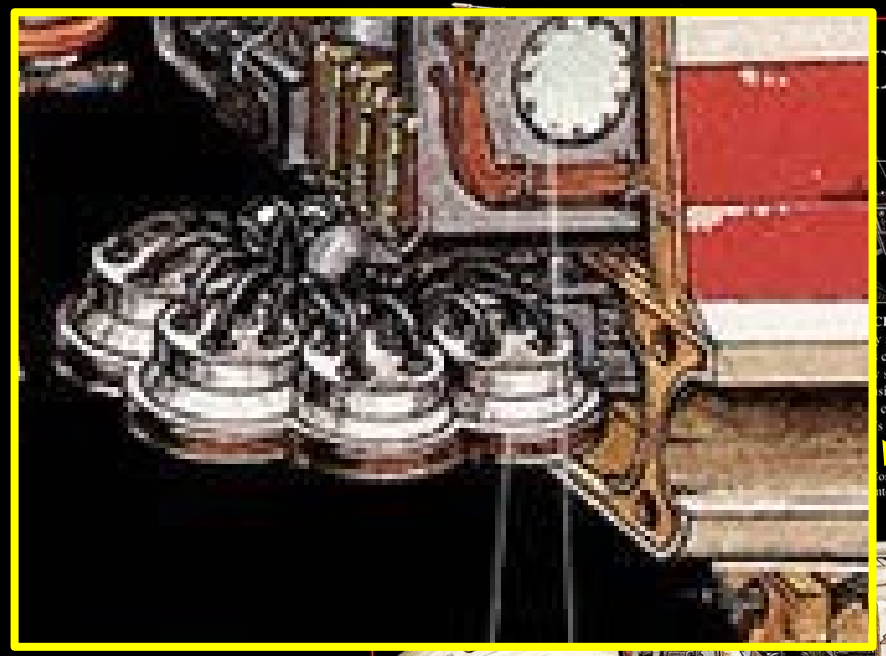
The X-wing's laser generators operate at the limits of safety to generate maximum destructive power. The long cannons of the X-wing develop longer range for its lasers, which can engage an oncoming enemy before the enemy can return fire.

Destroyer of the Death Star

Proton torpedoes such as the MG7-As carried by the X-wing are extremely dangerous focused nuclear explosives. They are used for critical target destruction or to punch through ray shielding that will deflect laser weapons. Proton torpedoes are very expensive and available to Alliance forces only in limited numbers. Luke Skywalker carried only a single pair for his critical shots that destroyed the original Death Star.

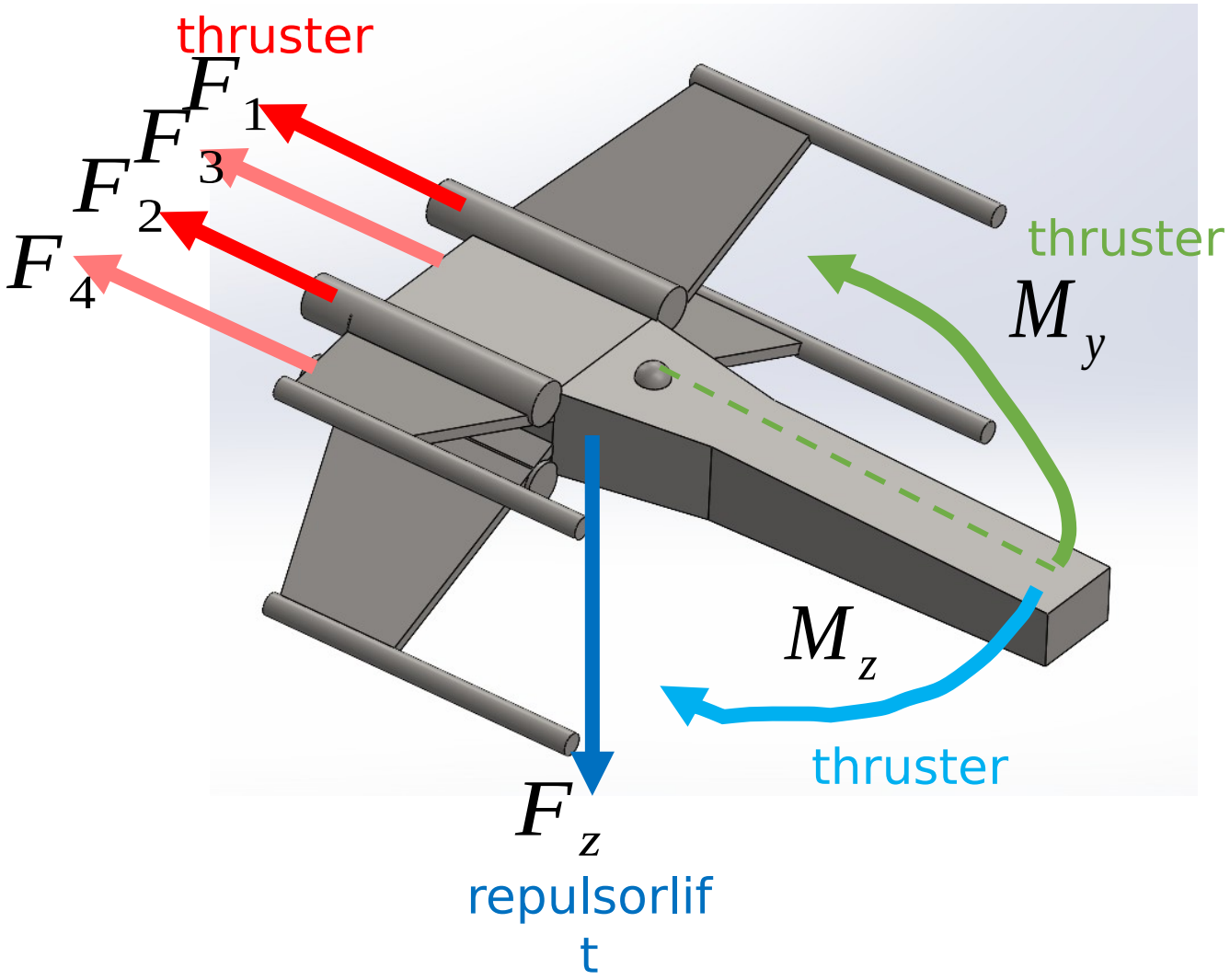
A high-energy launch cartridge fires each torpedo, giving it thrust and trajectory guidance through a precise gyroscopic spin

X-Wing Fighter Model: Upward



X-Wing Fighter Model

Model



X-Wing Fighter Model: Slowing Down

Slowing Down??

What allows Star Wars ships to slow down?

See parent question

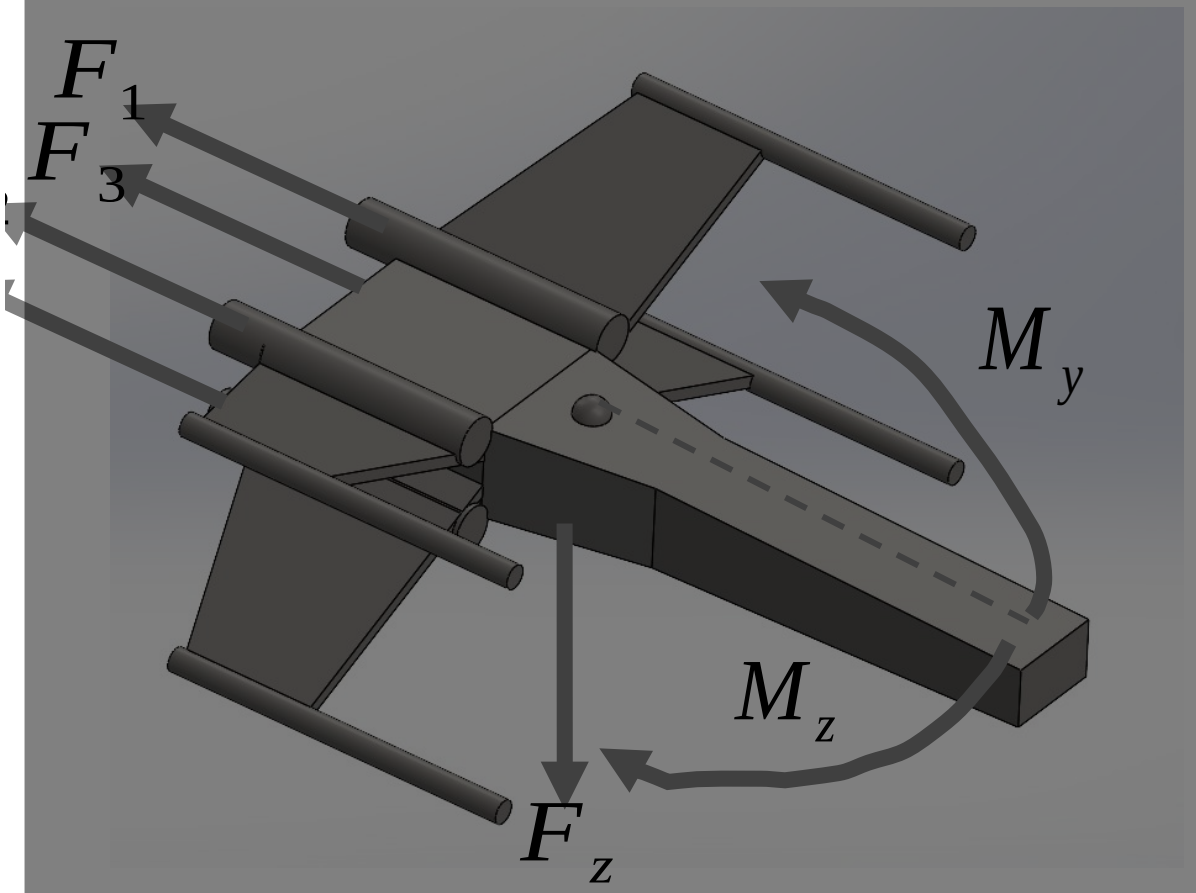
Follow · 1 Request

1 Answer

Joe Corica
Author · 9mo

In-universe, "inertial dampeners" and what we'd call "retro rockets", small rockets firing in the opposite direction serving as brakes.

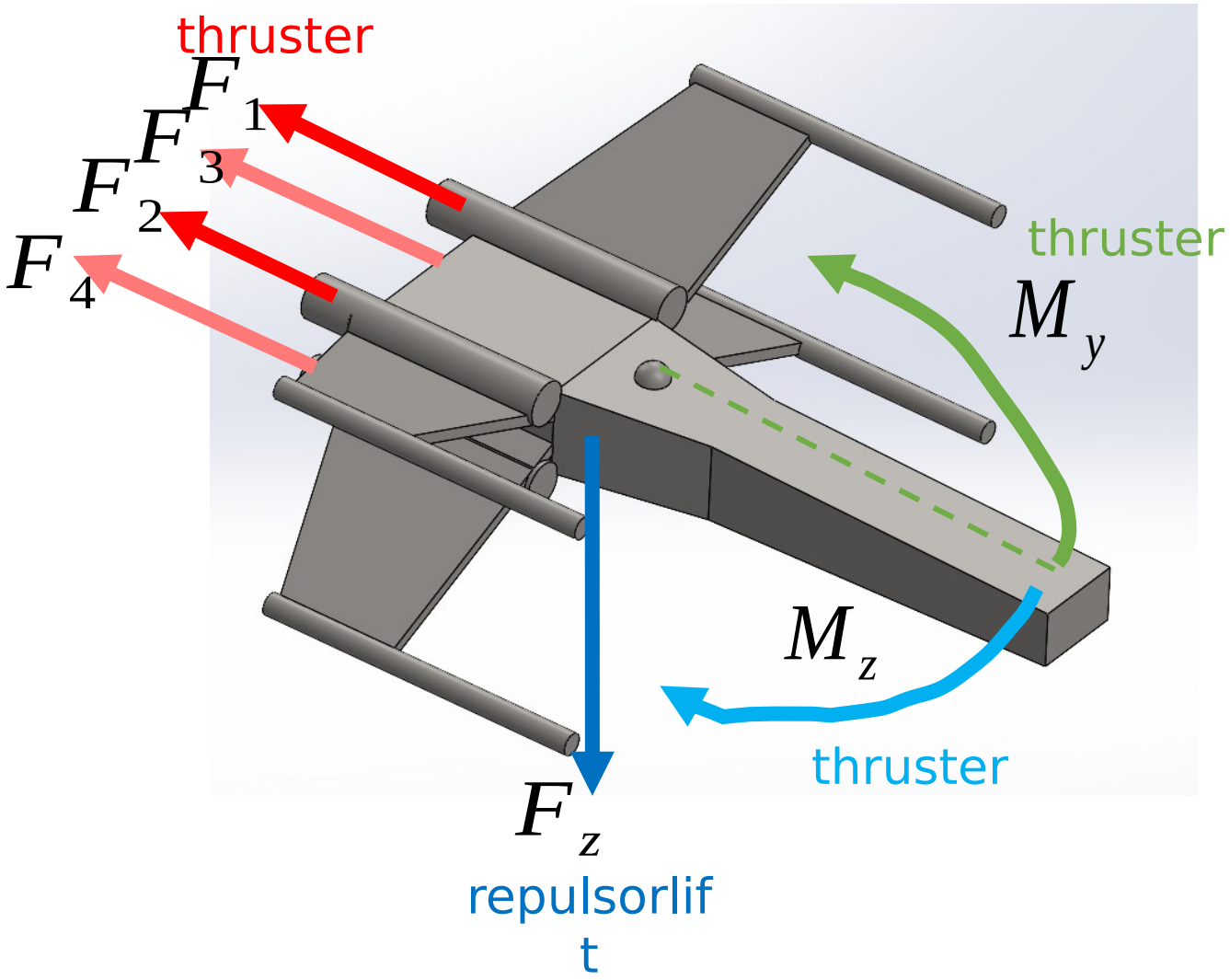
Model



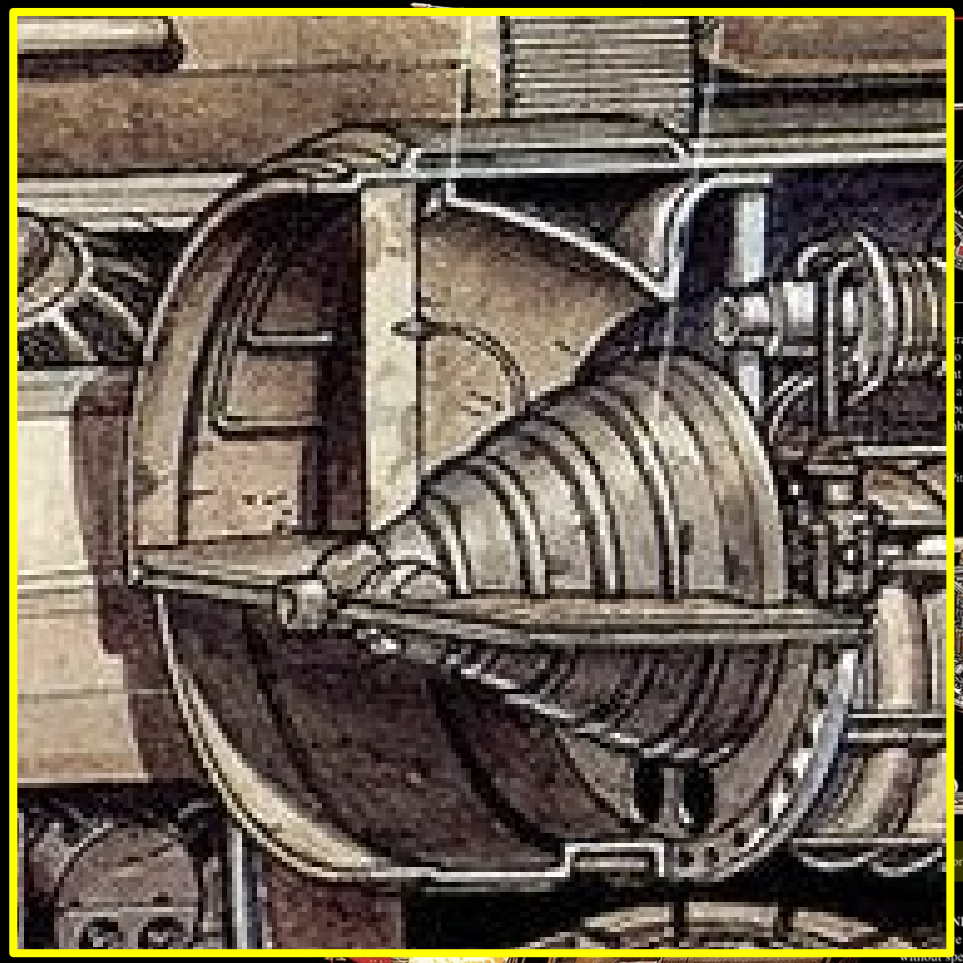
X-Wing Fighter Model: Roll

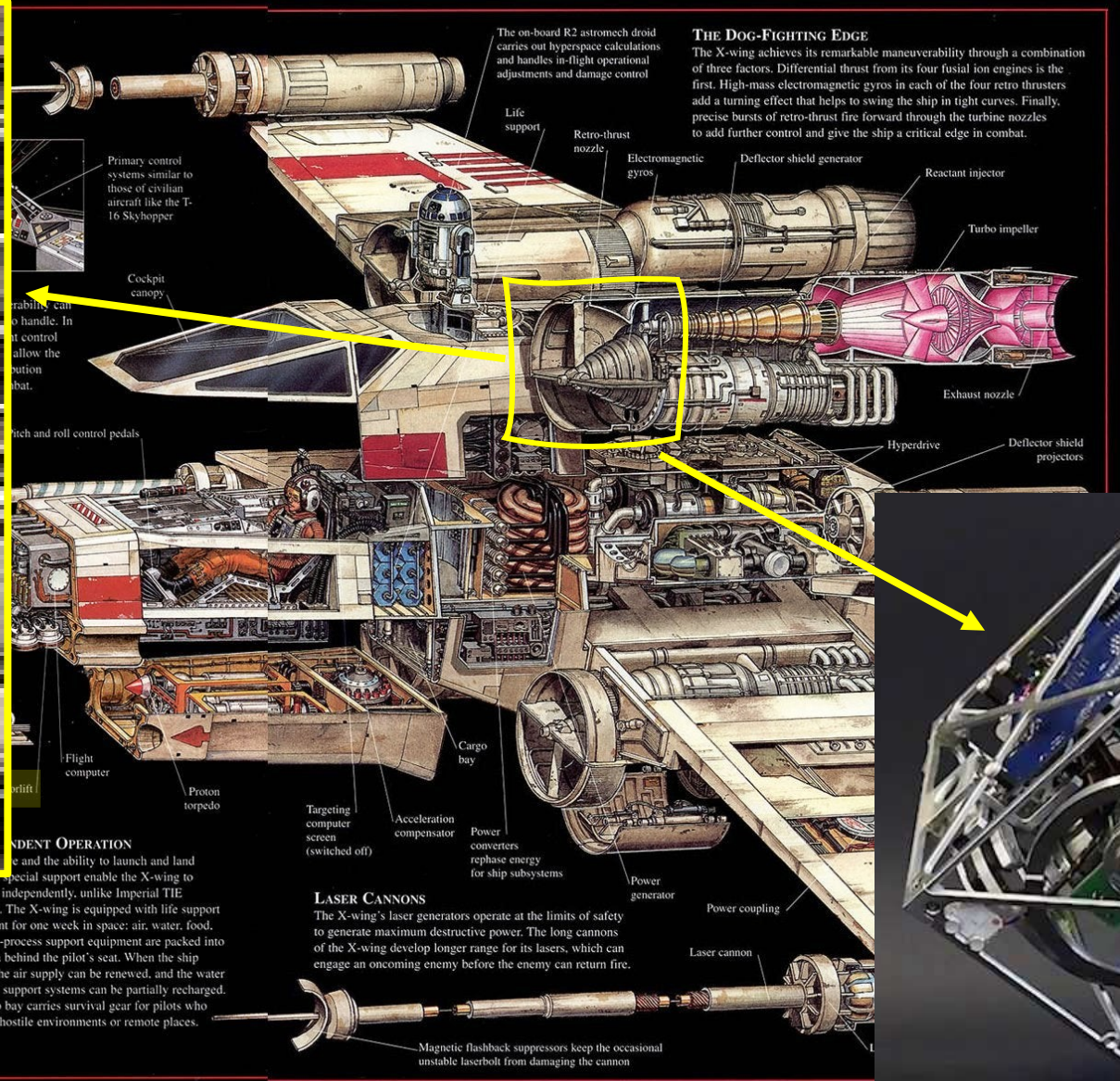
Rolling??

Model



X-Wing Fighter Model: Roll





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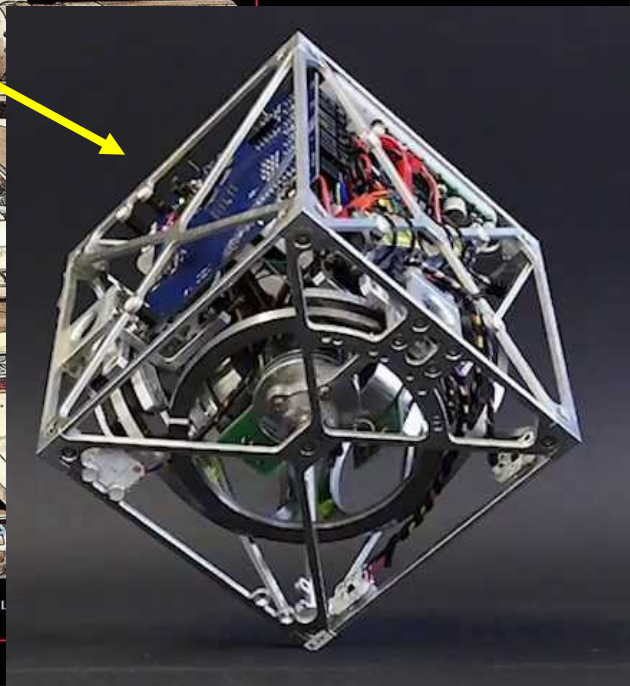
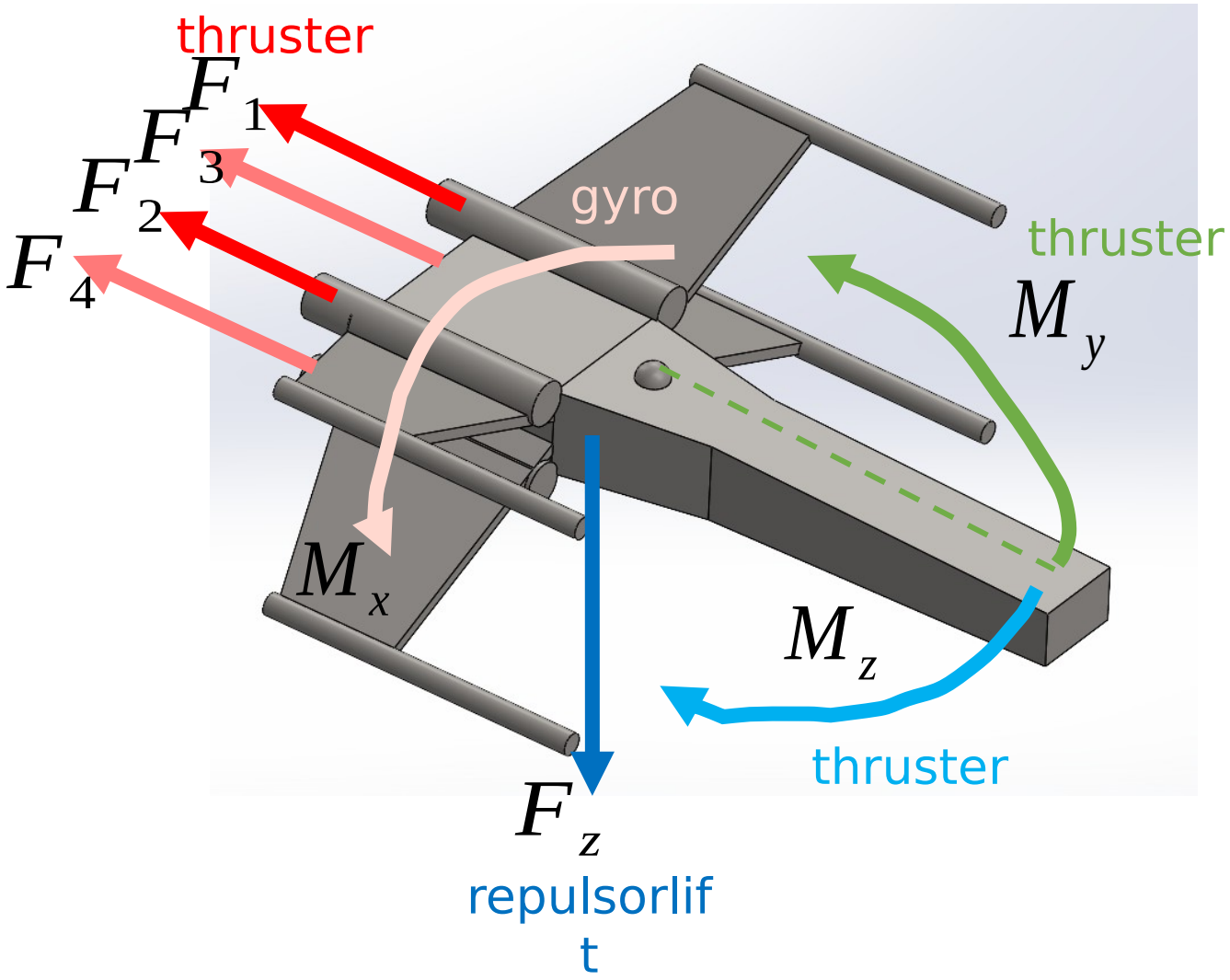


X-Wing Fighter Model

Model



X-Wing Fighter Model

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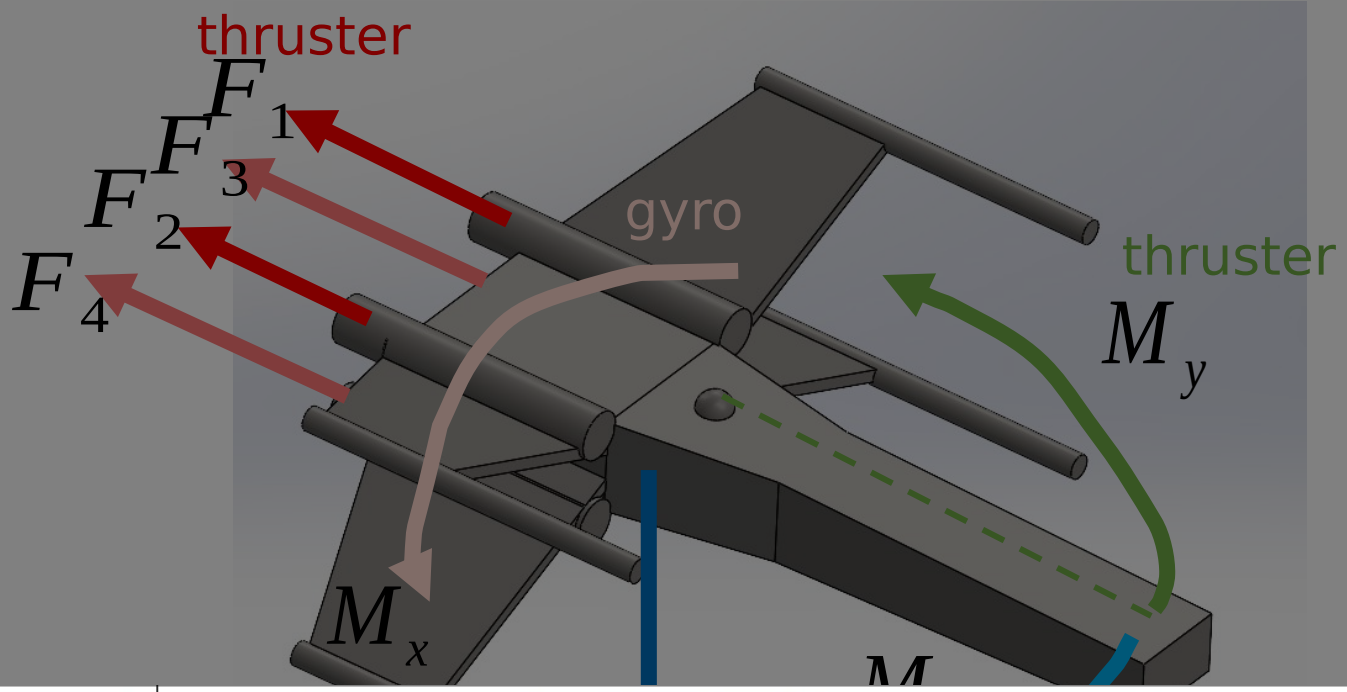

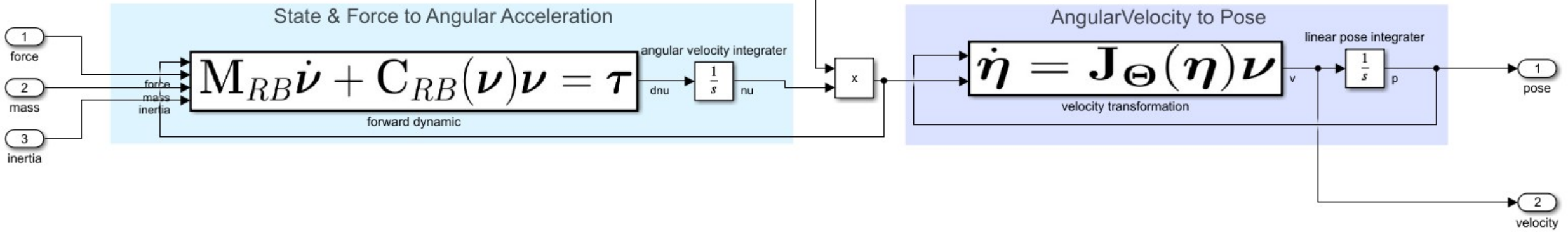

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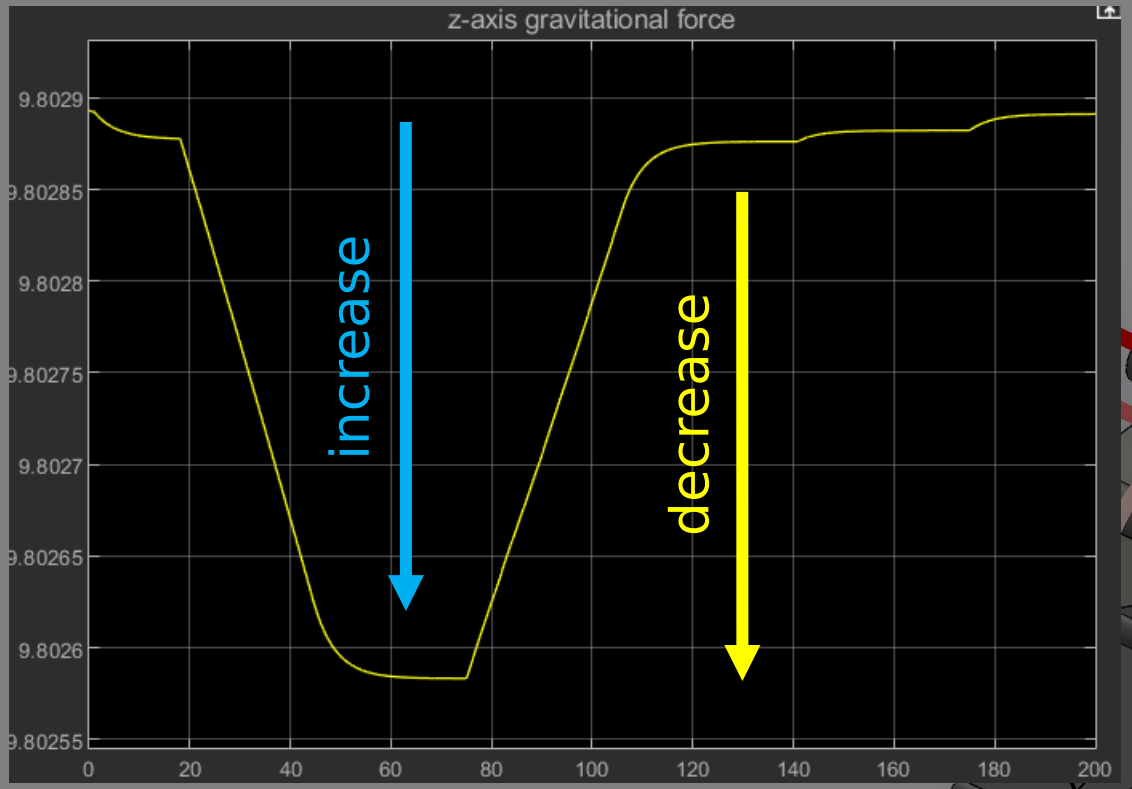

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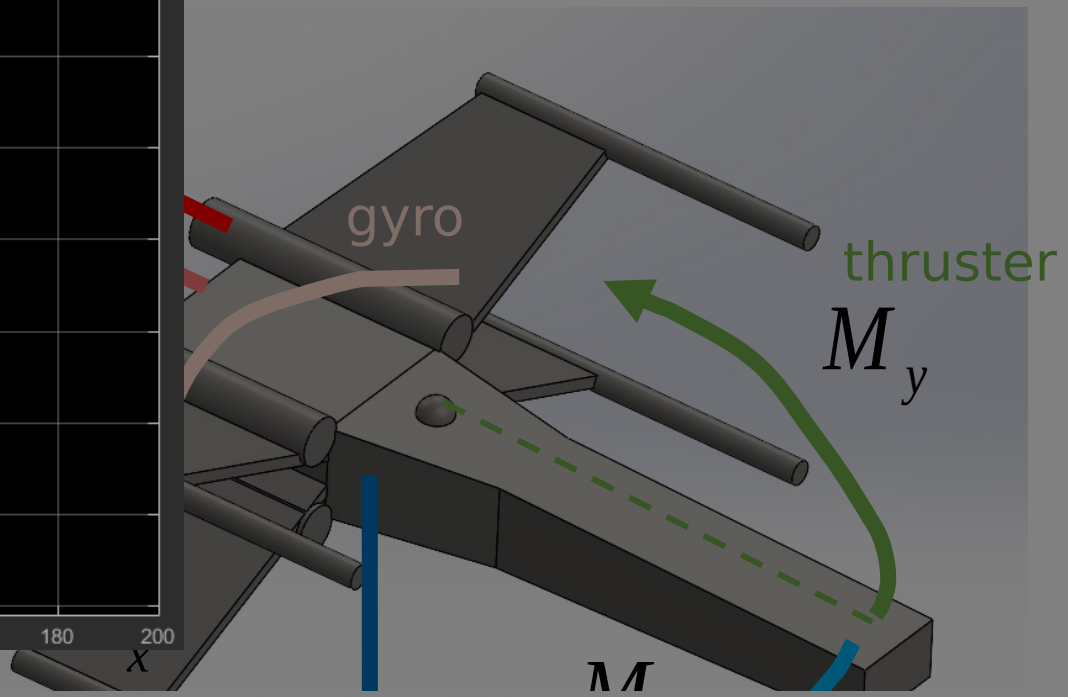
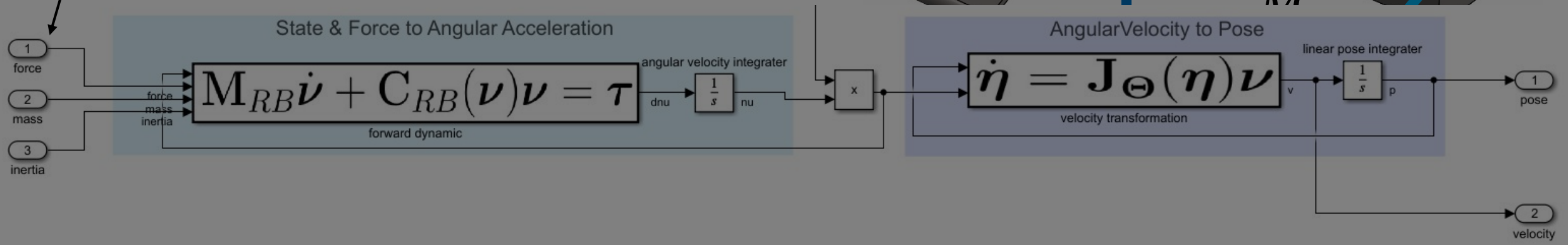
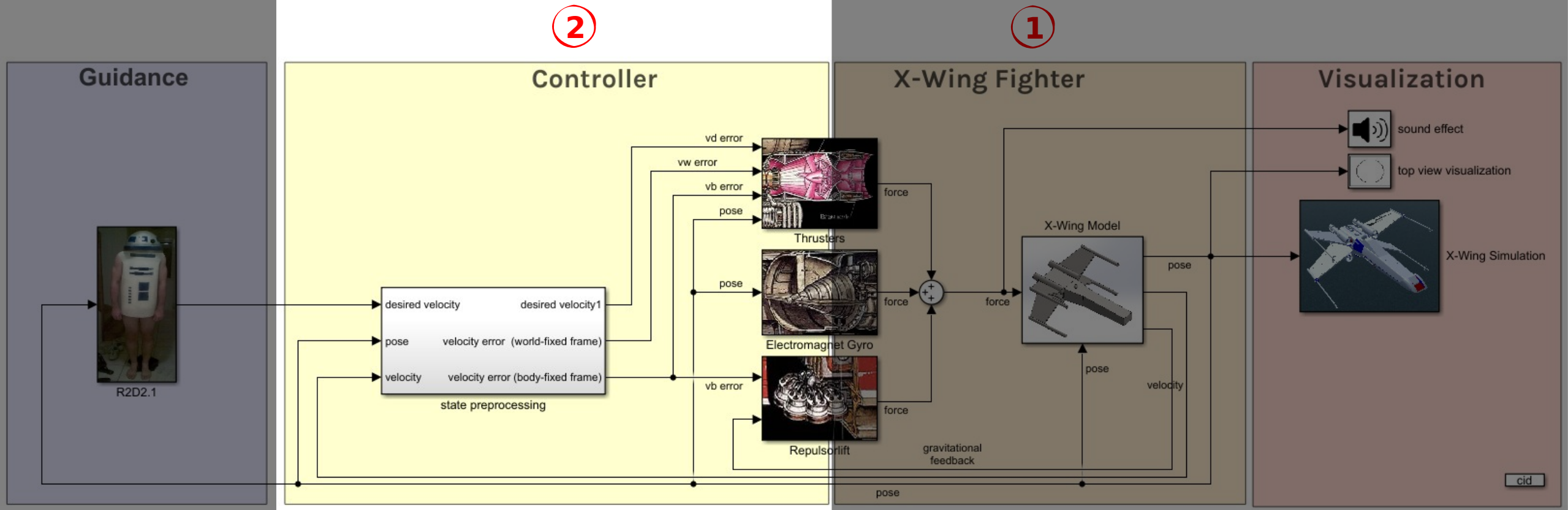


$$F_g = G\frac{m_1 m_2}{r^2}$$



Overview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force
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velocity
gravitational feedback
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sound effect
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cid

Control

fwrd/bwrd ->

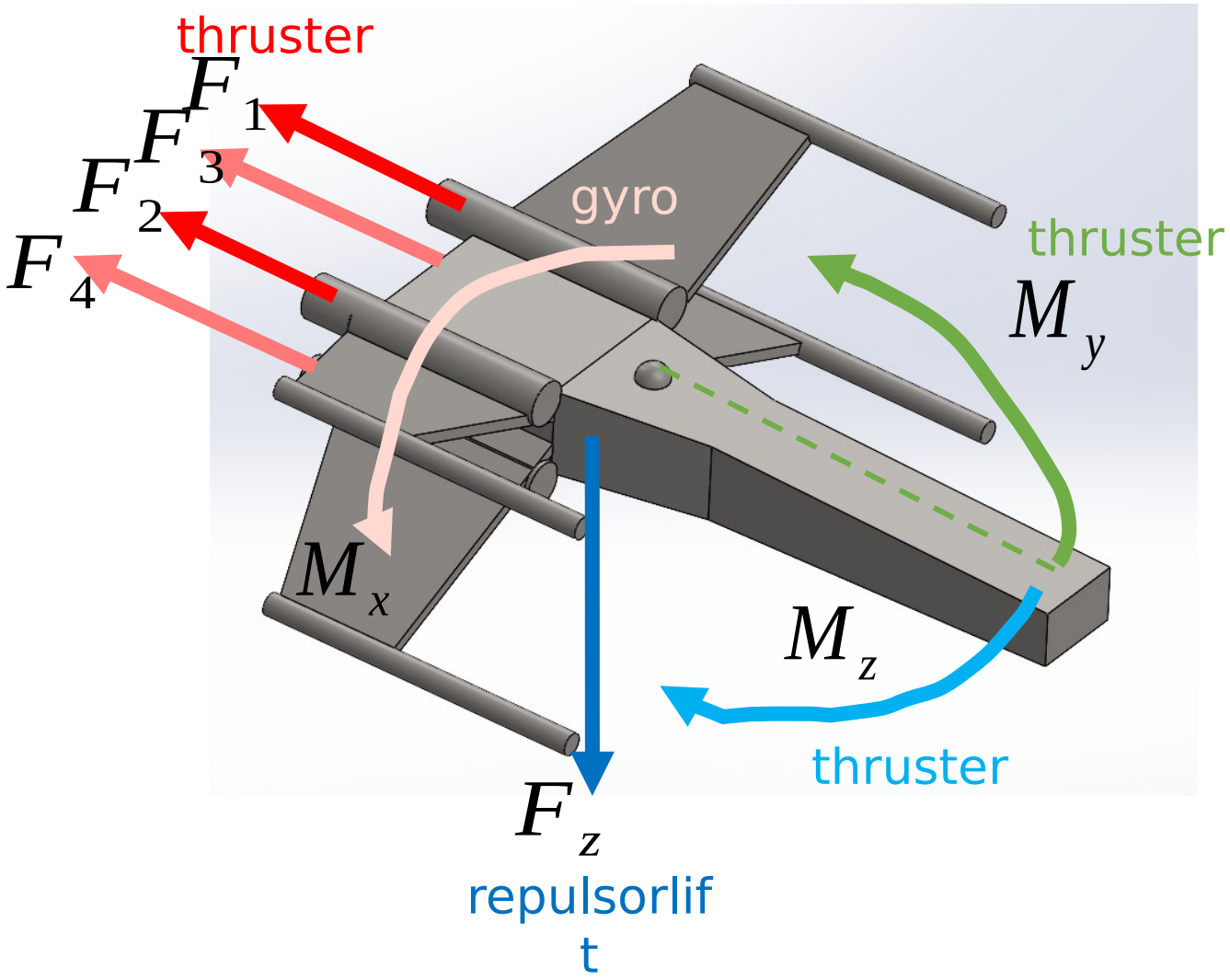
up/down ->

roll ->

pitch ->

yaw ->

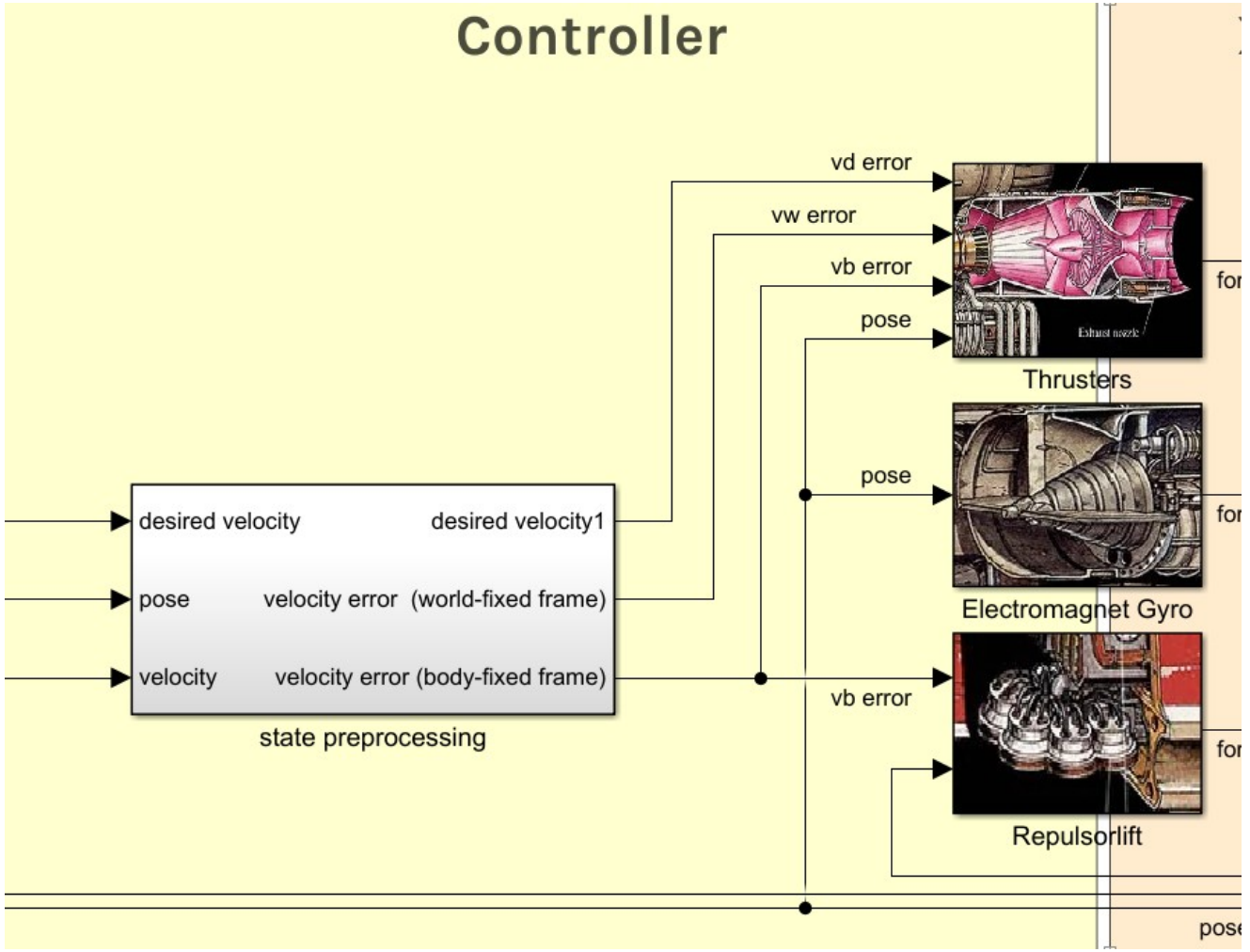
Model



Control

Velocity Control

$$\begin{bmatrix} F_x \\ 0 \\ F_z \\ M_x \\ M_y \\ M_z \end{bmatrix} = f\left(\begin{bmatrix} PD(e_{vx}) \\ 0 \\ PD(e_{vz}) \\ PD(e_{roll}) \\ PD(e_{pitch} + g(e_{vz})) \\ PD(0 - v_y) \end{bmatrix}\right)$$



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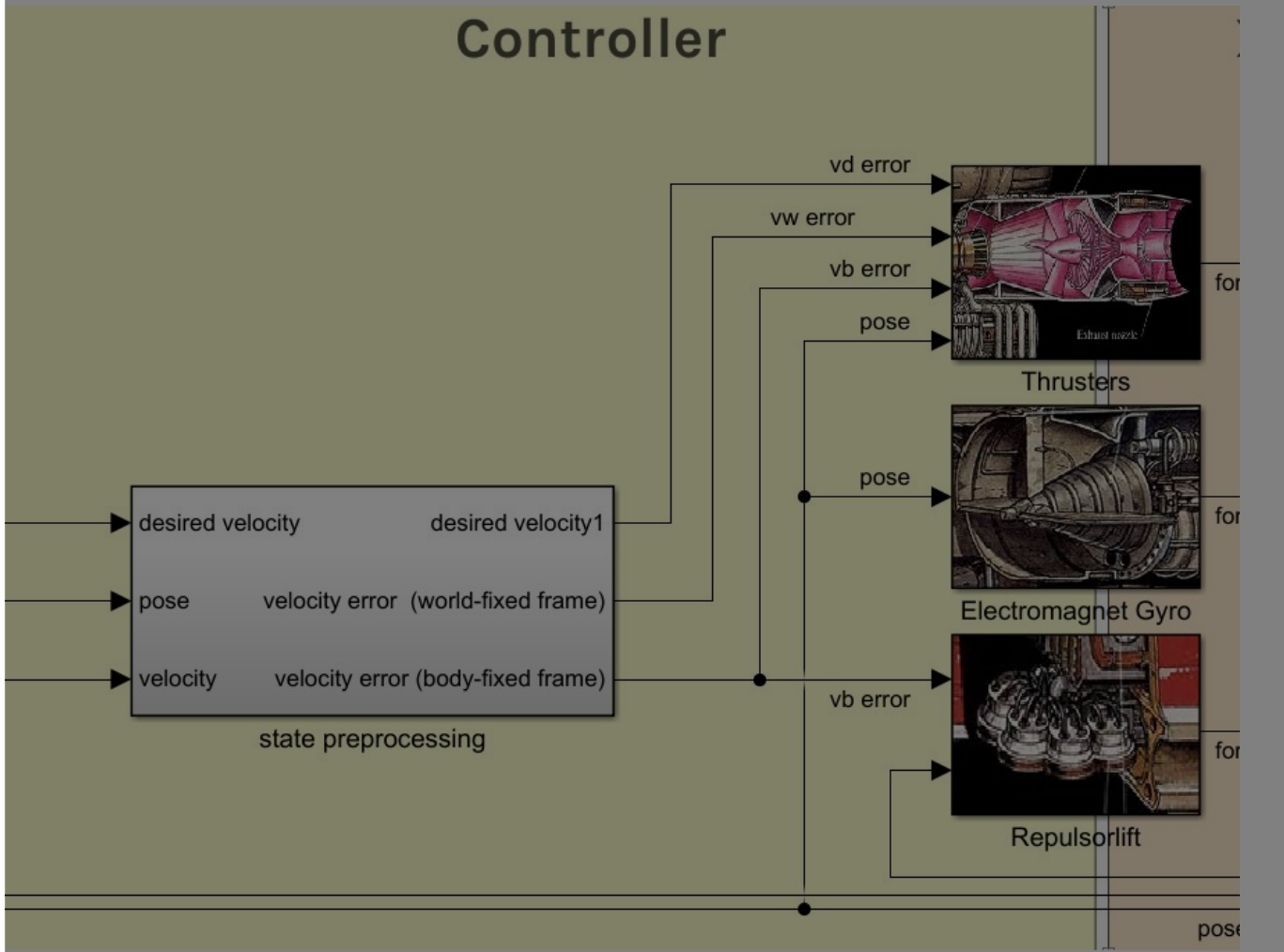
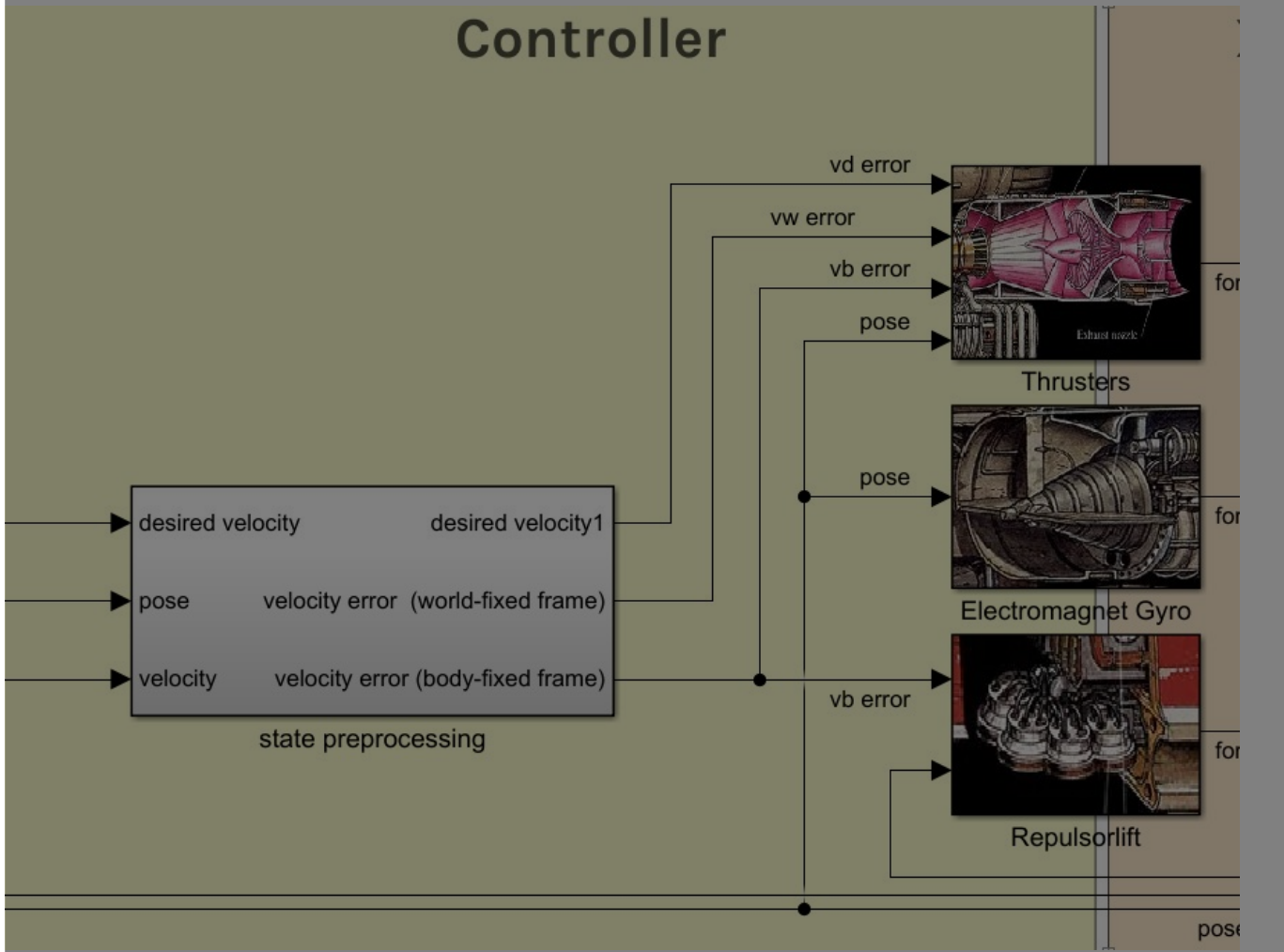


Control

Velocity Control

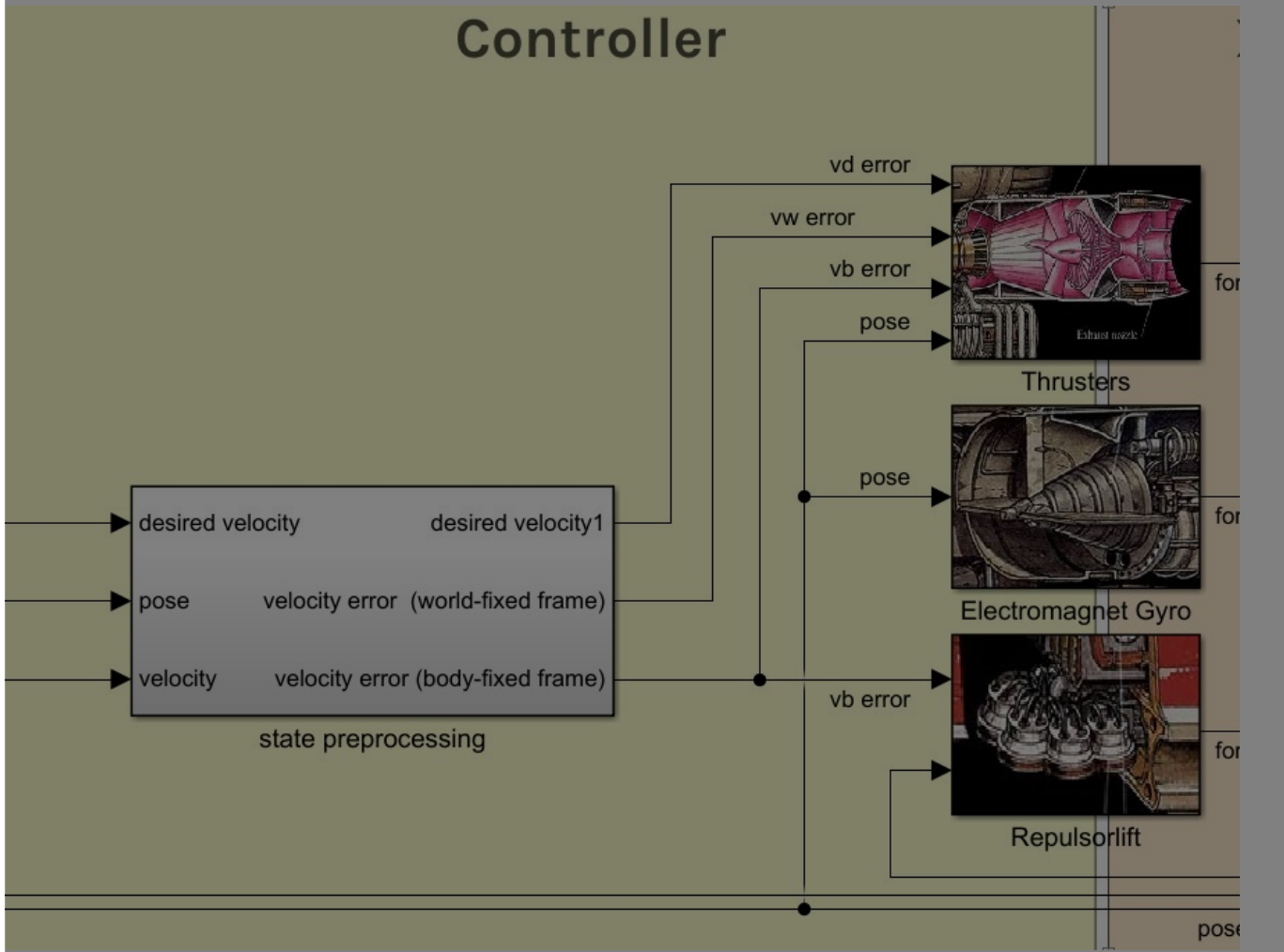
$$\begin{bmatrix} F_x \\ 0 \\ F_z \\ M_x \\ M_y \\ M_z \end{bmatrix} = f\left(\begin{bmatrix} PD(e_{vx}) \\ 0 \\ PD(e_{vz}) \\ PD(e_{roll}) \\ PD(e_{pitch} + g(e_{vz})) \\ PD(0 - v_y) \end{bmatrix}\right)$$



Control

Velocity Control

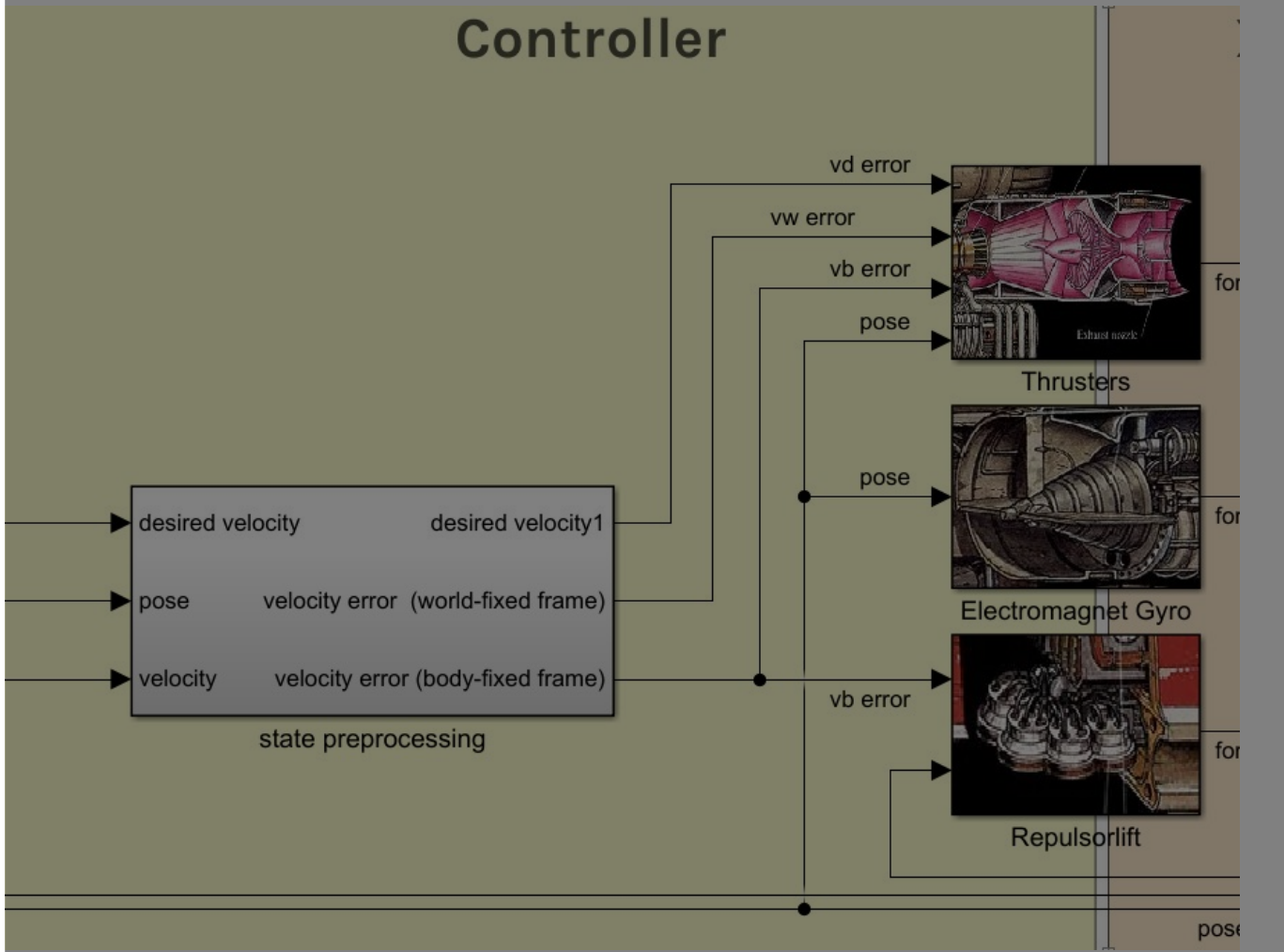
$$\begin{bmatrix} F_x \\ 0 \\ F_z \\ M_x \\ M_y \\ M_z \end{bmatrix} = f\left(\begin{bmatrix} PD(e_{vx}) \\ 0 \\ PD(e_{vz}) \\ PD(e_{roll}) \\ PD(e_{pitch} + g(e_{vz})) \\ PD(0 - v_y) \end{bmatrix}\right)$$



Control

Velocity Control

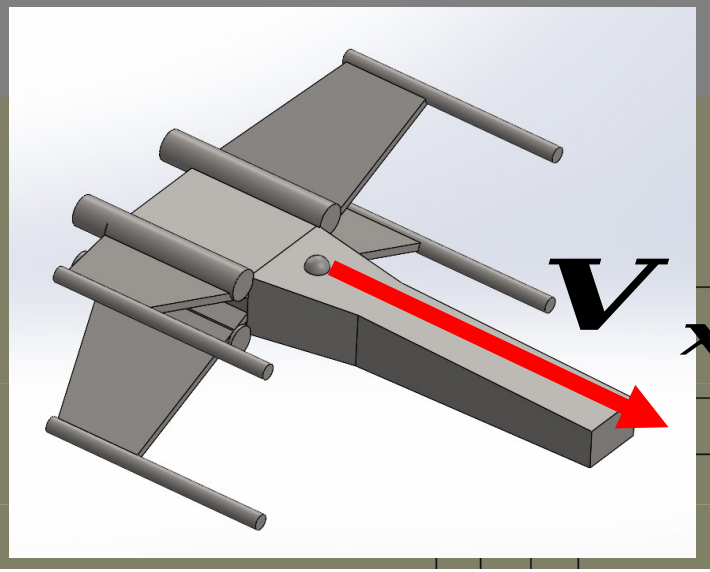
$$\begin{bmatrix} F_x \\ 0 \\ F_z \\ M_x \\ M_y \\ M_z \end{bmatrix} = f\left(\begin{bmatrix} PD(e_{vx}) \\ 0 \\ PD(e_{vz}) \\ PD(e_{roll}) \\ PD(e_{pitch} + g(e_{vz})) \\ PD(0 - v_y) \end{bmatrix} \right)$$

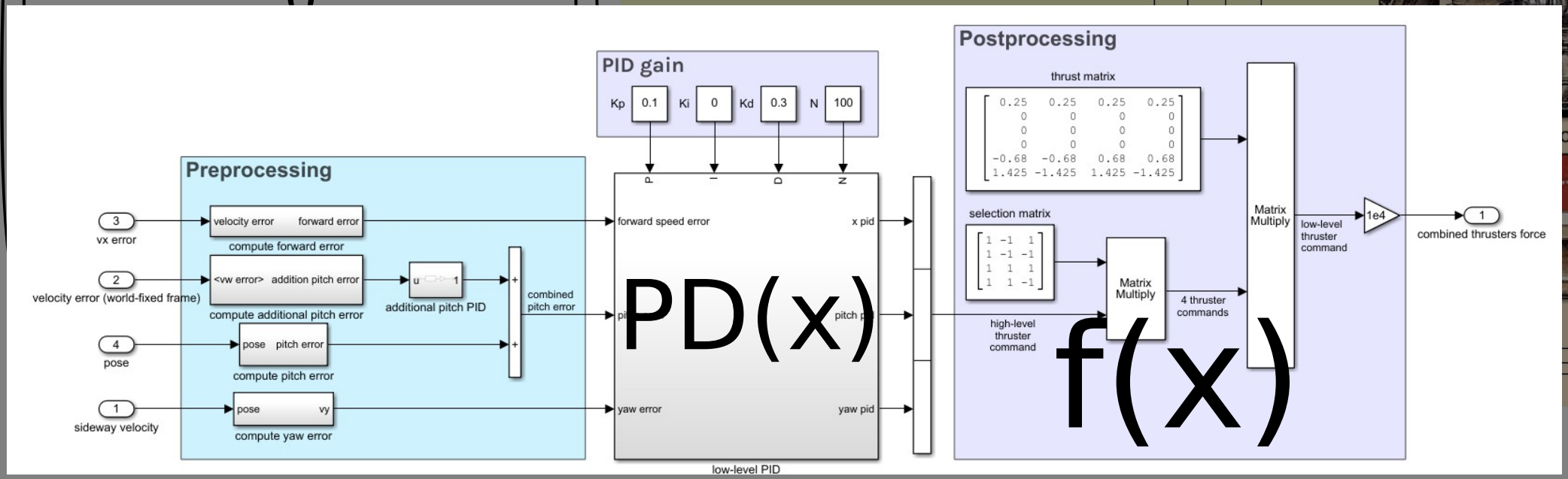


Control: forward

Velocity Control

$$\begin{bmatrix} F_x \\ 0 \\ F_z \\ M_x \\ M_y \\ M_z \end{bmatrix} = f\left(\begin{bmatrix} PD(e_{vx}) \\ 0 \end{bmatrix} \right)$$

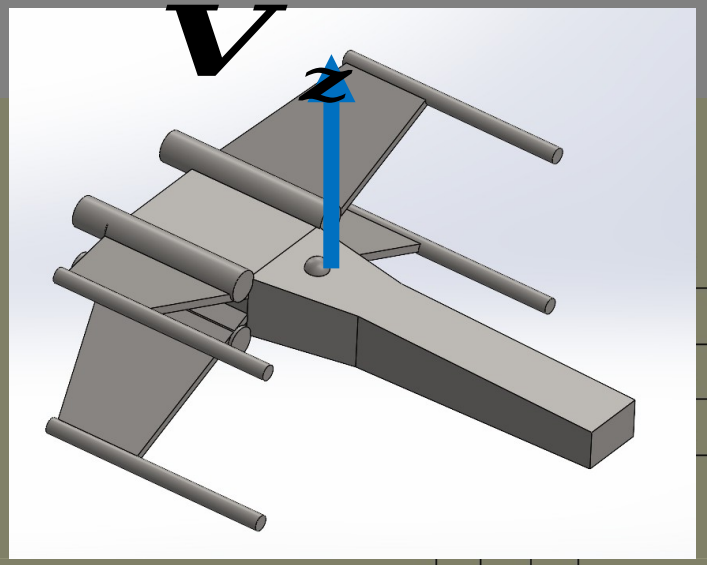


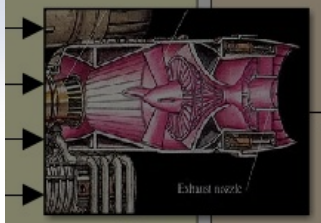


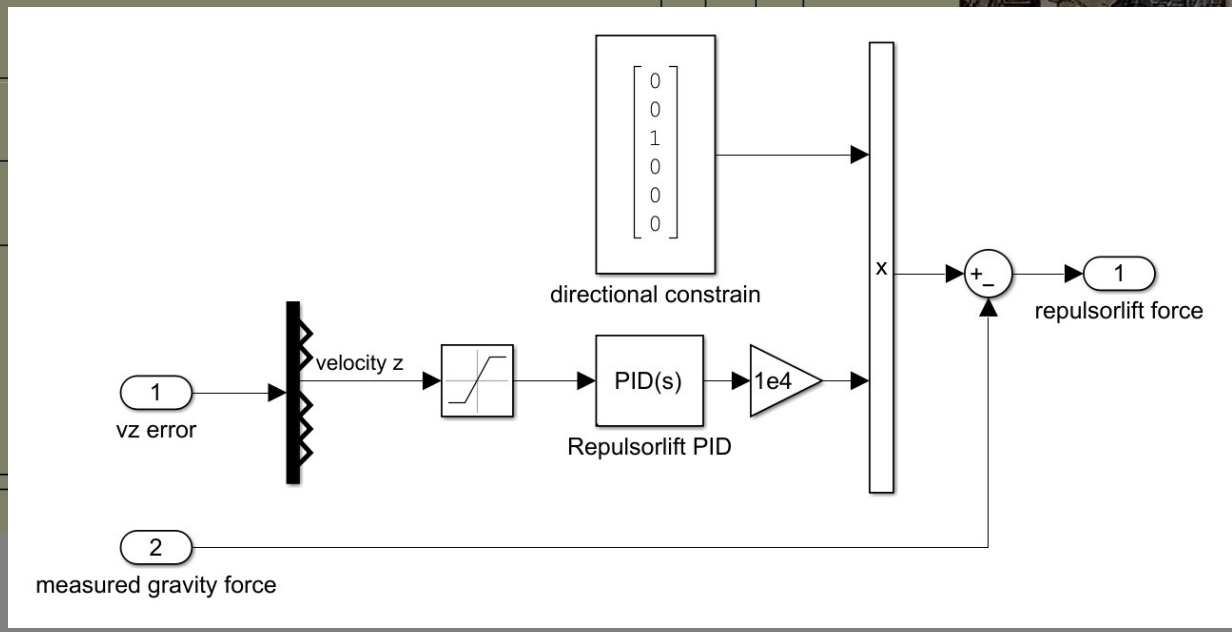
Control: attitude

Velocity Control

$$\begin{bmatrix} F_x \\ 0 \\ F_z \\ M_x \\ M_y \\ M_z \end{bmatrix} = f\left(\begin{bmatrix} PD(e_{vx}) \\ 0 \\ PD(e_{vz}) \\ PD(e_{roll}) \\ PD(e_{pitch} + g(e_{vz})) \\ PD(0 - v_y) \end{bmatrix}\right)$$



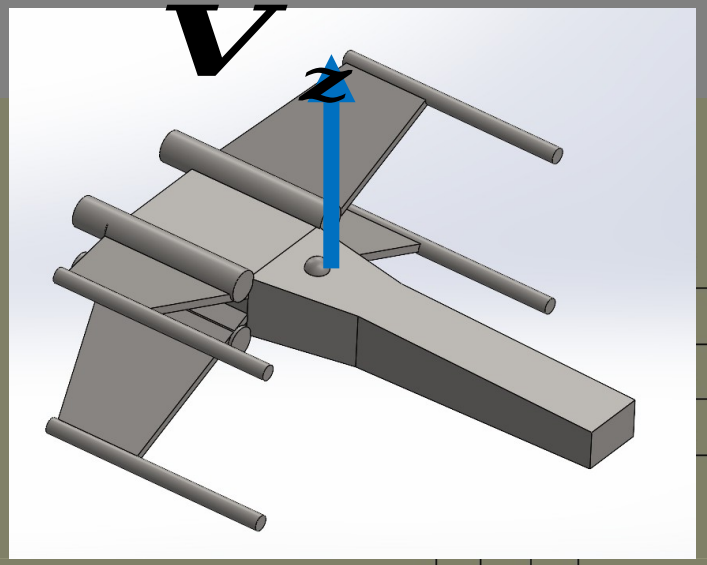


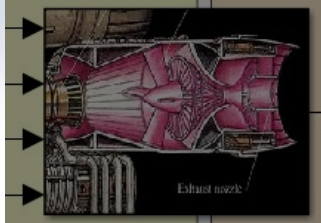


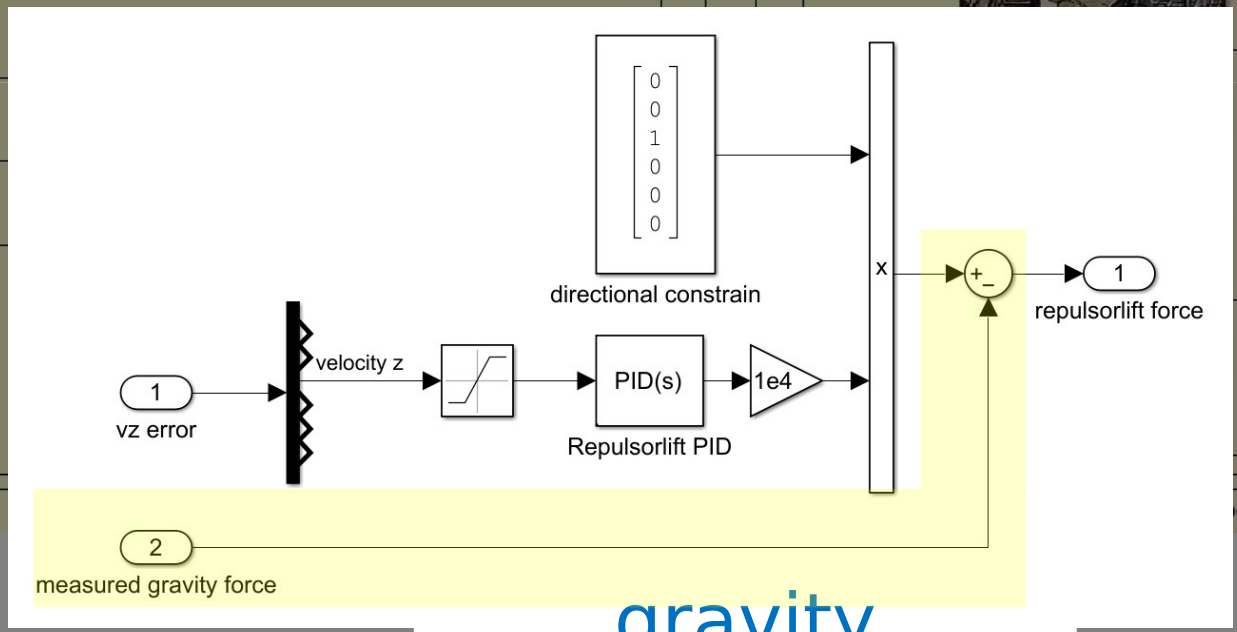
Control: attitude

Velocity Control

$$\begin{bmatrix} F_x \\ 0 \\ F_z \\ M_x \\ M_y \\ M_z \end{bmatrix} = f\left(\begin{bmatrix} PD(e_{vx}) \\ 0 \\ PD(e_{vz}) \\ PD(e_{roll}) \\ PD(e_{pitch} + g(e_{vz})) \\ PD(0 - v_y) \end{bmatrix} \right)$$





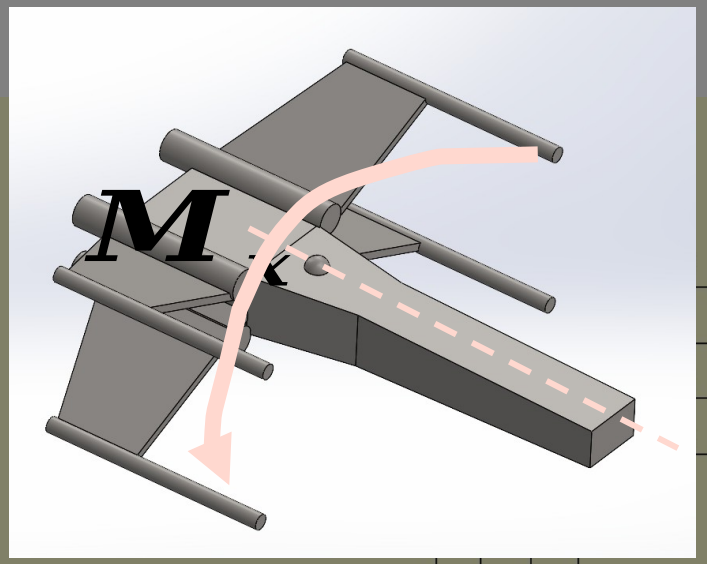


gravity

Control: roll

Velocity Control

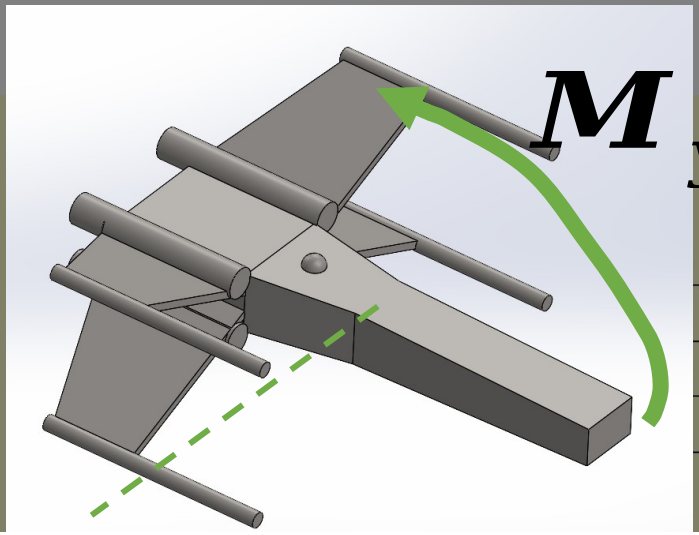
$$\begin{bmatrix} F_x \\ 0 \\ F_z \\ M_x \\ M_y \\ M_z \end{bmatrix} = f\left(\begin{bmatrix} PD(e_{vx}) \\ 0 \\ PD(e_{vz}) \\ PD(e_{roll}) \\ PD(e_{pitch} + g(e_{vz})) \\ PD(0 - v_y) \end{bmatrix} \right)$$

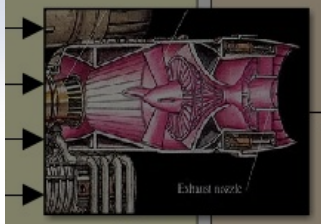


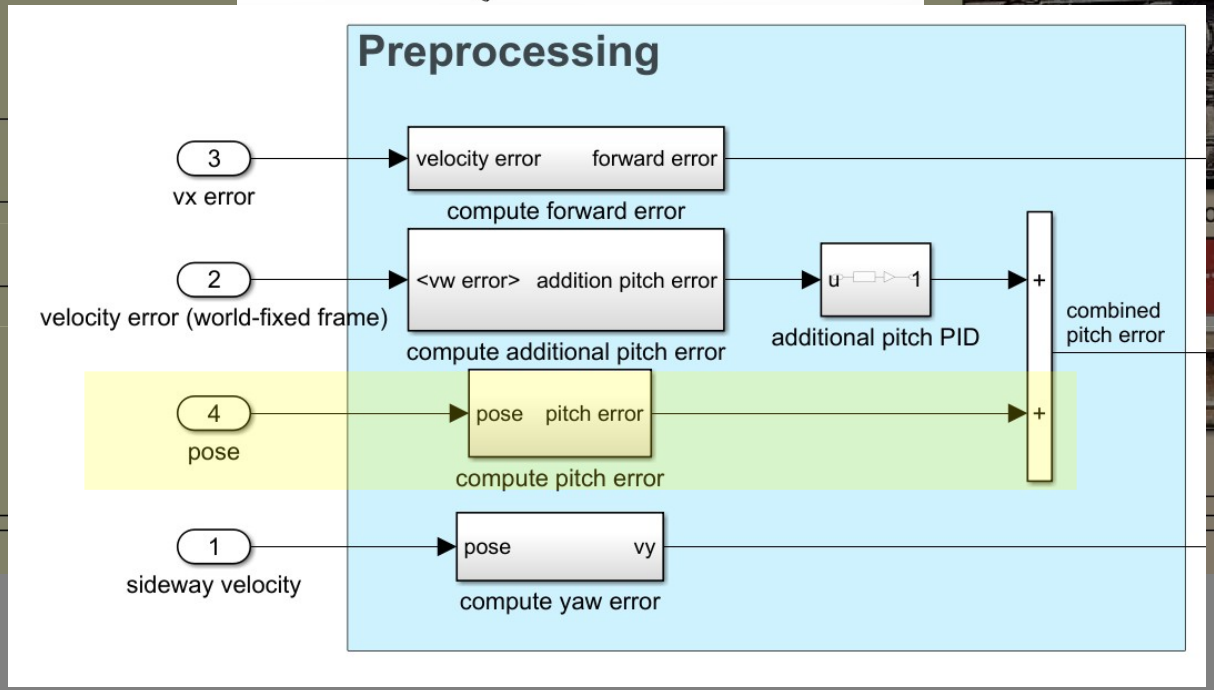
Control: pitch

Velocity Control

$$\begin{bmatrix} F_x \\ 0 \\ F_z \\ M_x \\ M_y \\ M_z \end{bmatrix} = f\left(\begin{bmatrix} PD(e_{vx}) \\ 0 \\ PD(e_{vz}) \\ PD(e_{roll}) \\ PD(e_{pitch} + g(e_{vz})) \\ PD(0 - v_y) \end{bmatrix} \right)$$



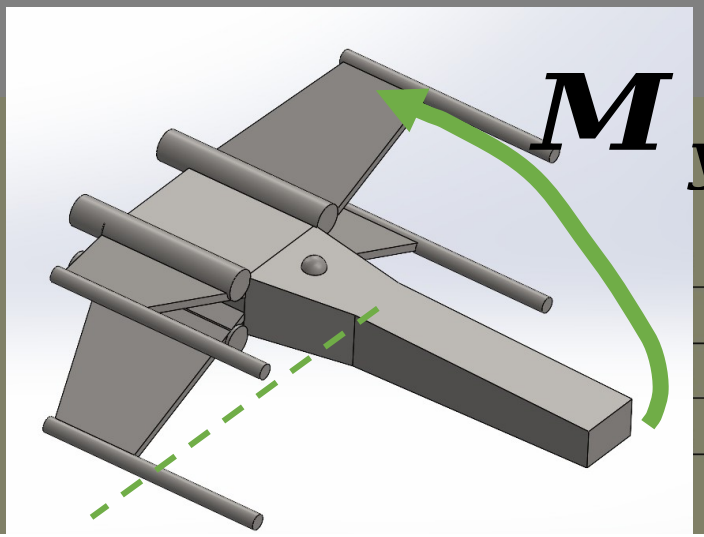


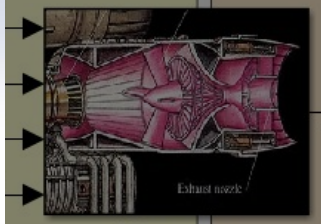


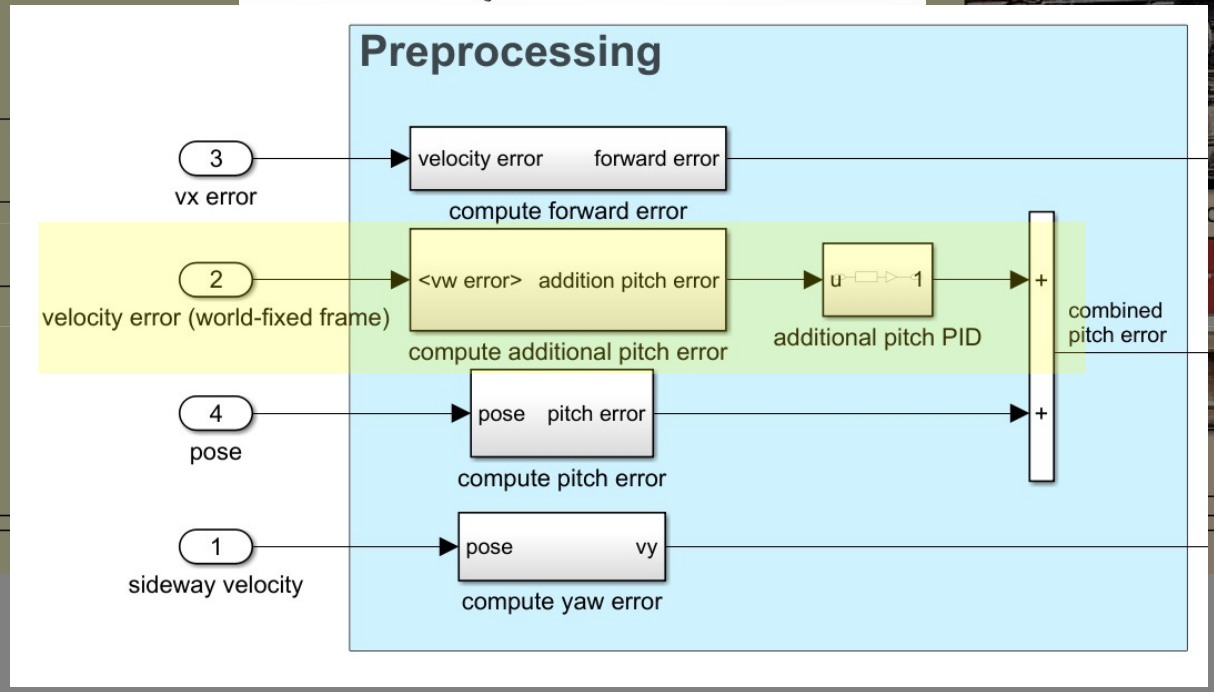
Control: pitch

Velocity Control

$$\begin{bmatrix} F_x \\ 0 \\ F_z \\ M_x \\ M_y \\ M_z \end{bmatrix} = f\left(\begin{bmatrix} PD(e_{vx}) \\ 0 \\ PD(e_{vz}) \\ PD(e_{roll}) \\ PD(e_{pitch} + g(e_{vz})) \\ PD(0 - v_y) \end{bmatrix}\right)$$



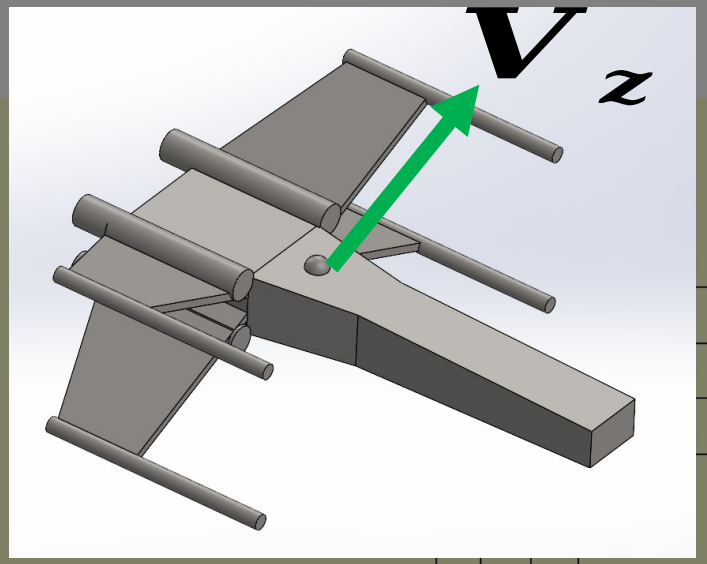




Control: yaw

Velocity Control

$$\begin{bmatrix} F_x \\ 0 \\ F_z \\ M_x \\ M_y \\ M_z \end{bmatrix} = f\left(\begin{bmatrix} PD(e_{vx}) \\ 0 \\ PD(e_{vz}) \\ PD(e_{roll}) \\ PD(e_{pitch} + g(e_{vz})) \\ PD(0 - v_y) \end{bmatrix} \right)$$



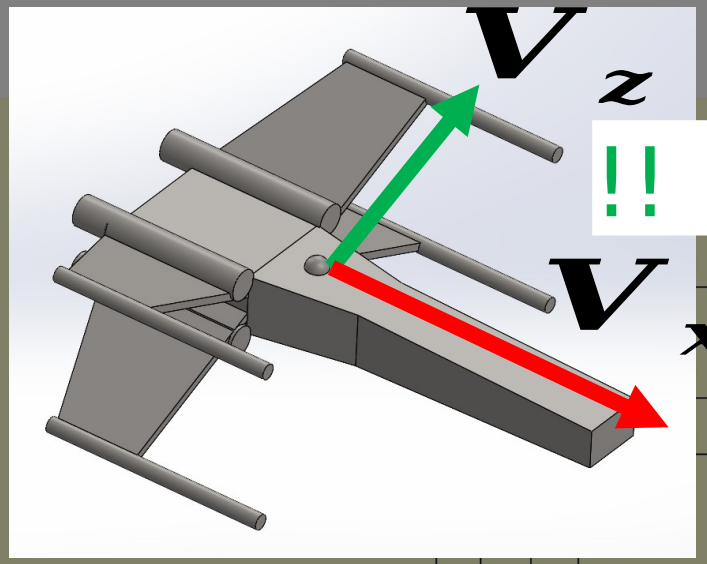
Control: yaw

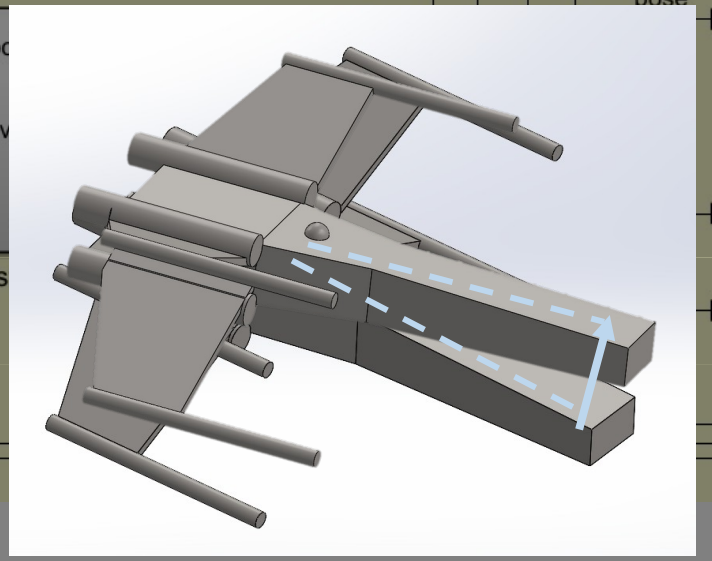
Velocity Control

$$v_y \rightarrow 0$$

$$\min_u (v_y)^2$$

$$\begin{bmatrix} F_x \\ 0 \\ F_z \\ M_x \\ M_y \\ M_z \end{bmatrix} = f\left(\begin{bmatrix} PD(e_{vz}) \\ PD(e_{roll}) \\ PD(e_{pitch} + g(e_{vz})) \\ PD(0 - v_y) \end{bmatrix} \right)$$

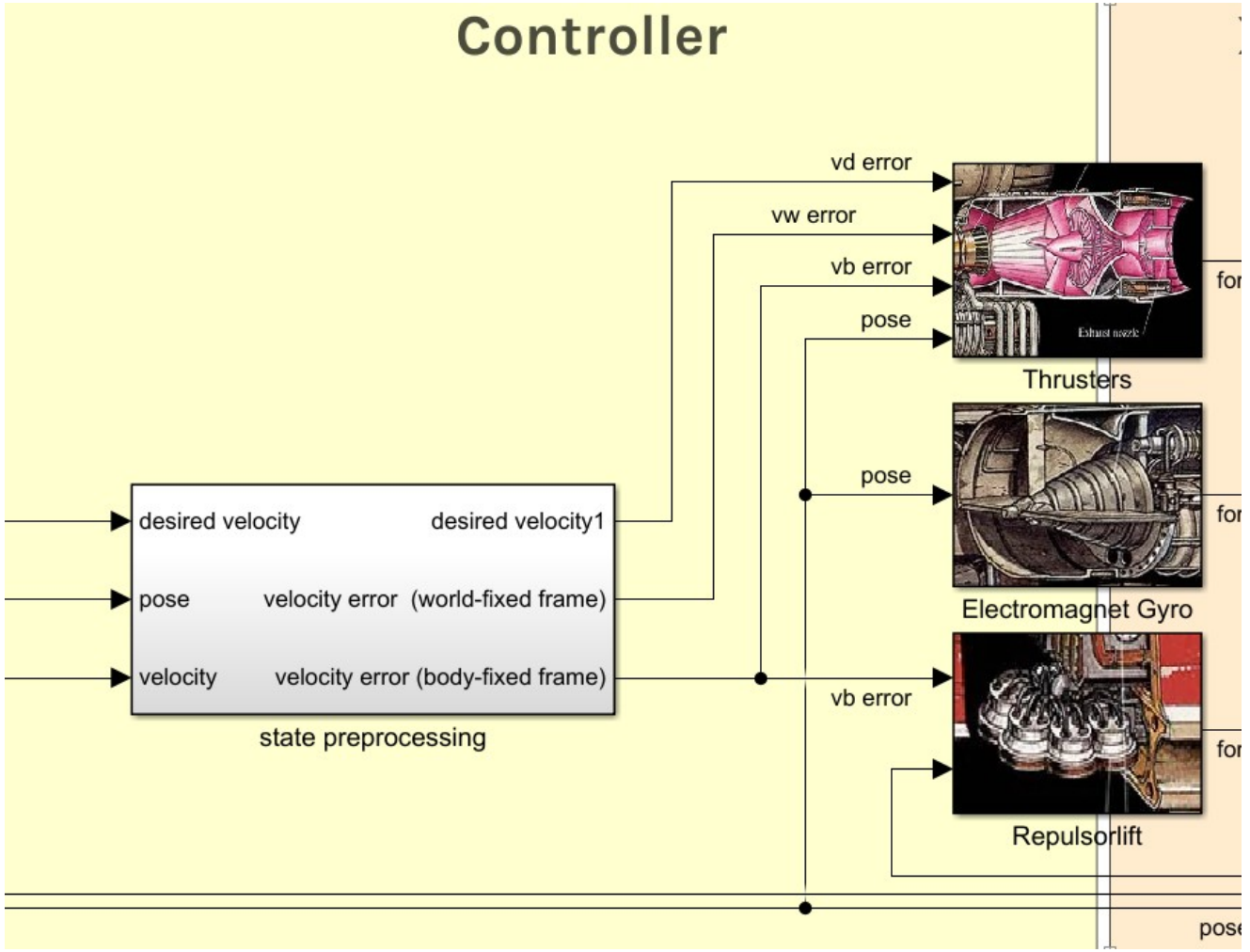




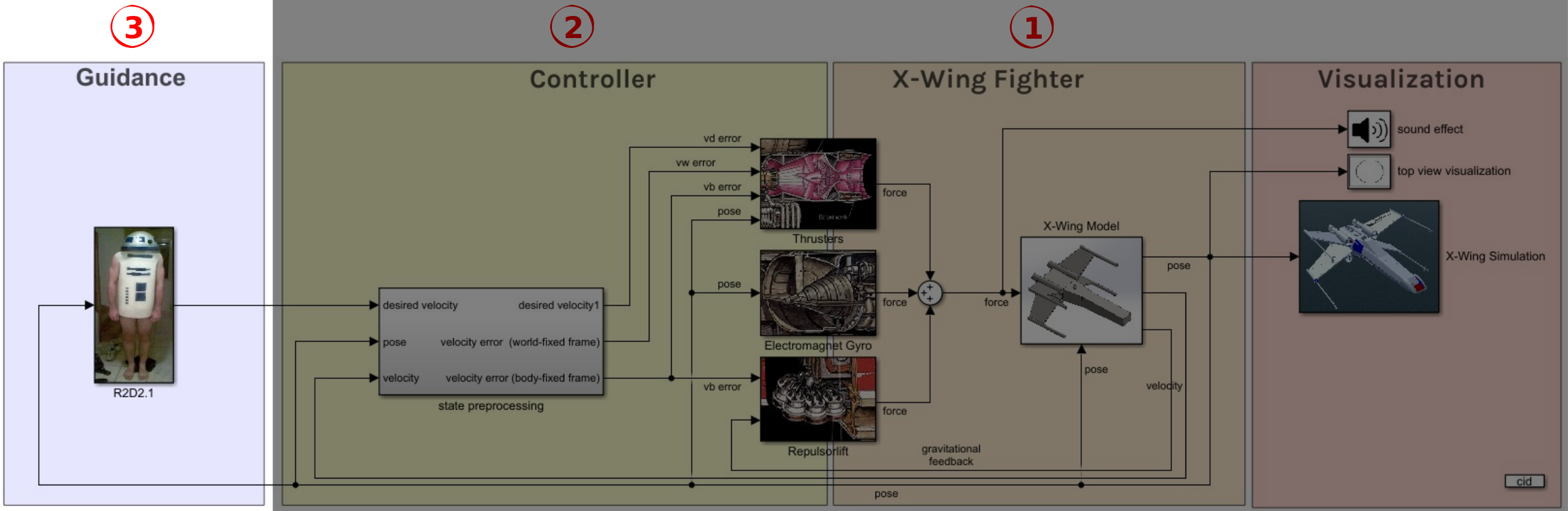
Control

Velocity Control

$$\begin{bmatrix} v_x \\ v_y \\ v_z \\ roll \\ pitch \\ yaw \end{bmatrix} \rightarrow \begin{bmatrix} v_x \\ v_y \\ v_z \\ 0 \\ 0 \\ 0 \end{bmatrix}$$

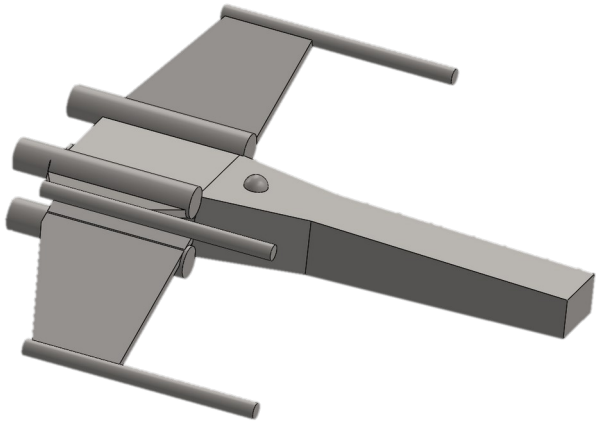


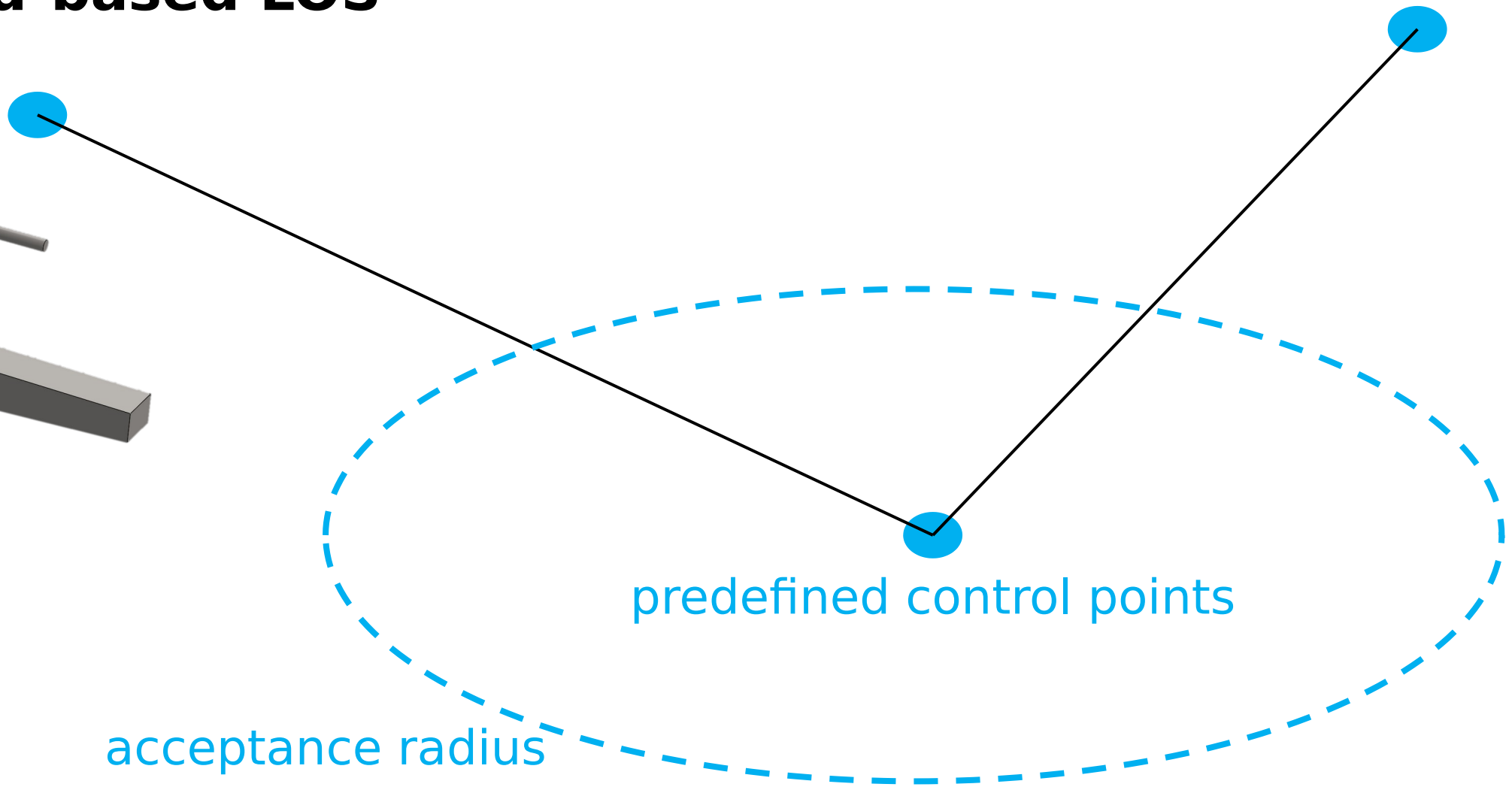
Overview


3
2
1
Guidance
Controller
X-Wing Fighter
Visualization
R2D2.1
desired velocity
desired velocity1
pose
velocity error (world-fixed frame)
velocity
velocity error (body-fixed frame)
state preprocessing
vd error
vw error
vb error
pose
Thrusters
Electromagnet Gyro
Repulsorlift
force
X-Wing Model
gravitational feedback
sound effect
top view visualization
X-Wing Simulation
cid

Guidance

Lookahead-based LOS guidance

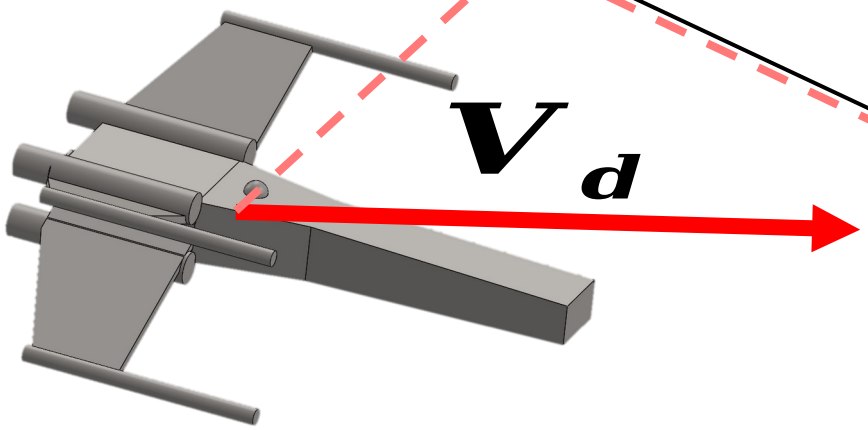




Guidance

Lookahead-based LOS guidance

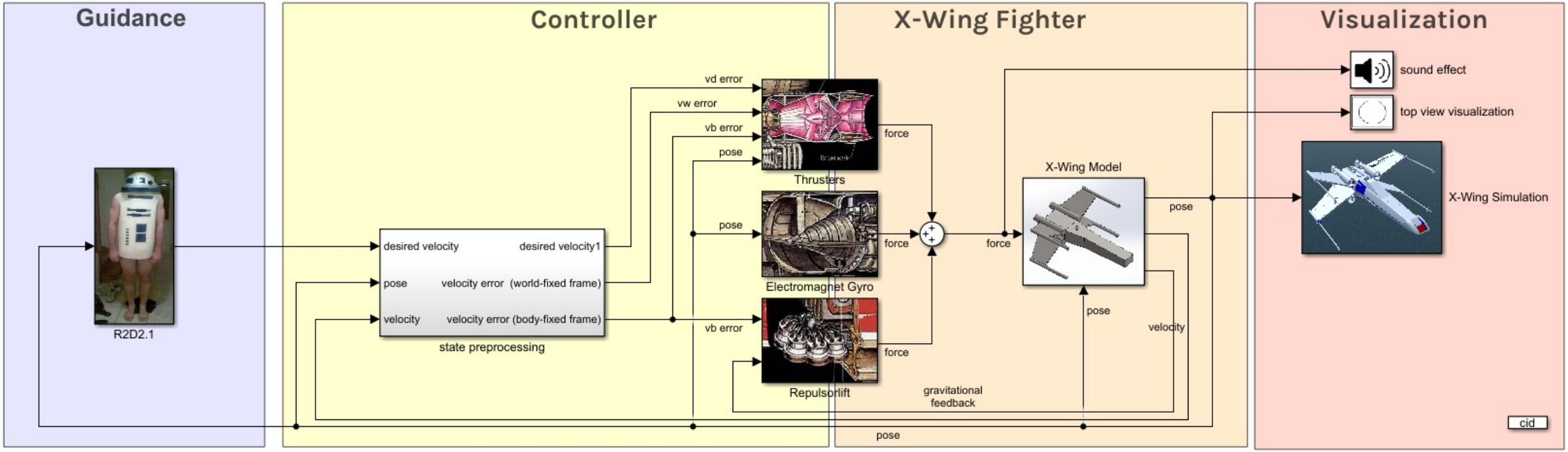
$$\mathbf{v}_d(t) := -k \frac{\mathbf{p}(t) - \mathbf{p}_{LOS}(t)}{\|\mathbf{p}(t) - \mathbf{p}_{LOS}(t)\|}$$



P_{LOS}

predefined control point

Summary


Guidance
R2D2.1
Controller
desired velocity
desired velocity1
pose
velocity error (world-fixed frame)
velocity
velocity error (body-fixed frame)
state preprocessing
vd error
vw error
vb error
pose
Thrusters
force
pose
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force
vb error
Repulsorlift
force
X-Wing Fighter
force
X-Wing Model
pose
pose
velocity
gravitational feedback
pose
Visualization
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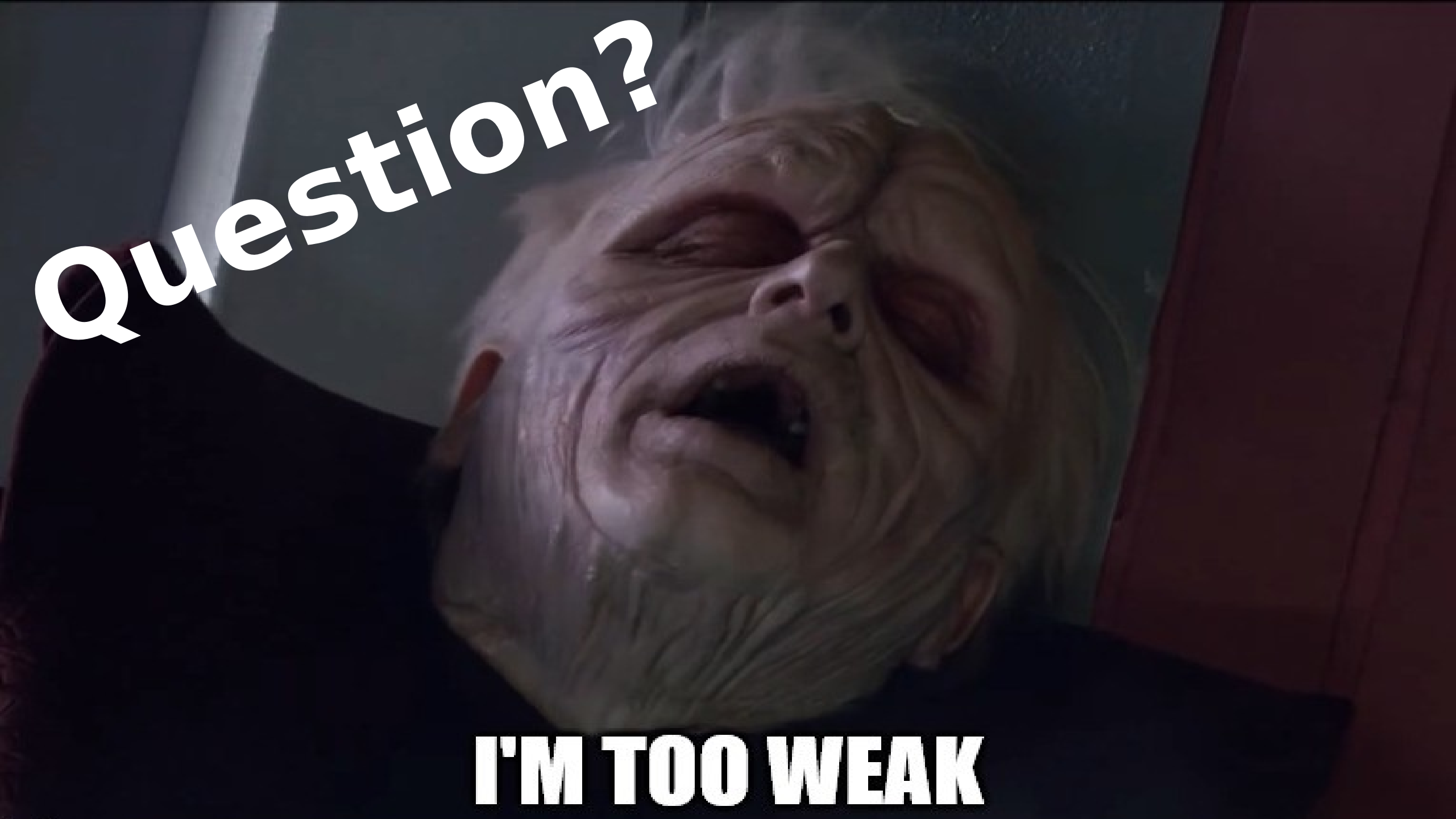
top view visualization
X-Wing Simulation
cid


Question?
I'M TOO WEAK