Example of **moveConstrained** task definition, with a goal position
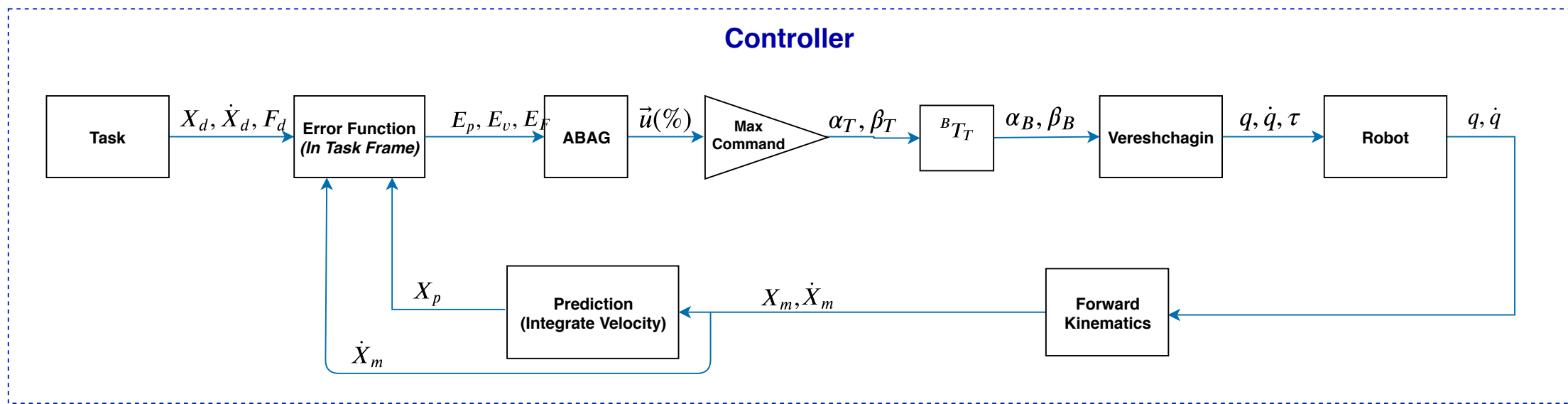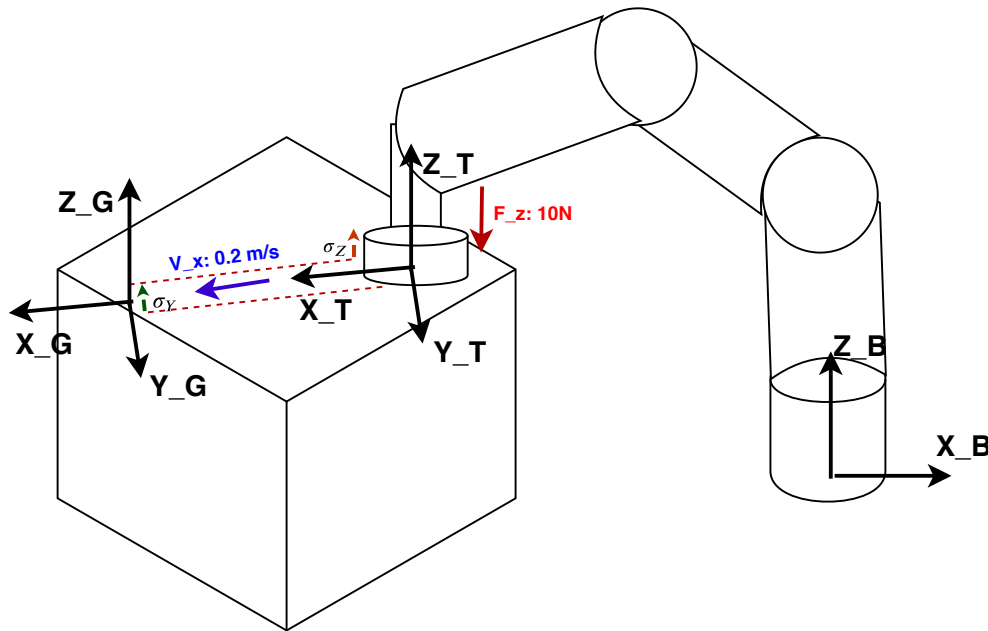
move compliantly { // *with task frame directions*

     * X_T: velocity motion profile (tube 0.01 m/s)
     * Y_T: position tube 0.03 m
     * Z_T: force profile (tube 0.5 N)
     * aX_T: force 0 N, tube 0.1 N
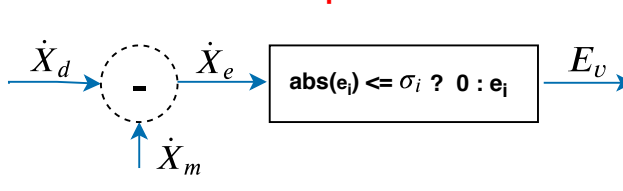   * aY_T: force 0 N, tube 0.1 N
     * aZ_T: velocity 0 rad/sec

} until: * distance in X > d m
            * F_x/F_y > 0.5 N
            * time > 20 sec

Objective (Error) function

Monitors (FSM)

Controller

Task → $X_d, \dot{X}_d, F_d$ → Error Function (In Task Frame) → E_p, E_v, E_F → ABAG → $\vec{u}(\%)$ → Max Command → α_T, β_T → $^B T_T$ → α_B, β_B → Vereshchagin → $q, \dot{q}, \tau$ → Robot → $q, \dot{q}$

Prediction (Integrate Velocity), X_p, $\dot{X}_m$, $X_m, \dot{X}_m$, Forward Kinematics

Error Function (In Task Frame)

Current Speed Error
$\dot{X}_d$ − $\dot{X}_m$ → $\dot{X}_e$ → $abs(e_i) <= \sigma_i$? 0 : e_i → E_v

Predicted Pose Error
X_d ⊗ X_p → X_e → R_e → Logarithmic Map → $\dot{X}_a$ → Compose Twist → $\dot{X}_e$ (Error Twist) → $abs(e_i) <= \sigma_i$? 0 : e_i → E_p, $P_e(\dot{X}_l)$

Current Force Error
F_d − F_m → F_e → $abs(ei) <= \sigma_i$? 0 : ei → E_F

ABAG
$E_{x,v}$ → 1D ABAG
$E_{y,p}$ → 1D ABAG
$E_{z,F}$ → 1D ABAG
$E_{ax,F}$ → 1D ABAG
$E_{ay,F}$ → 1D ABAG
$E_{az,p}$ → 1D ABAG
E_p, E_v, E_F → $\vec{u}(\%)$

Prediction (Integrate Velocity)
X_m, $X_{predicted}$ ⊗ $X_{relative}$ → Compose Pose → $R_{relative}$ → Exponential Map → $\dot{X}_a$ ← $\dot{X}_{scaled}$ ⊗ $\dot{X}_m$ ← T_p (Time Horizon), $\dot{X}_l (P_{relative})$
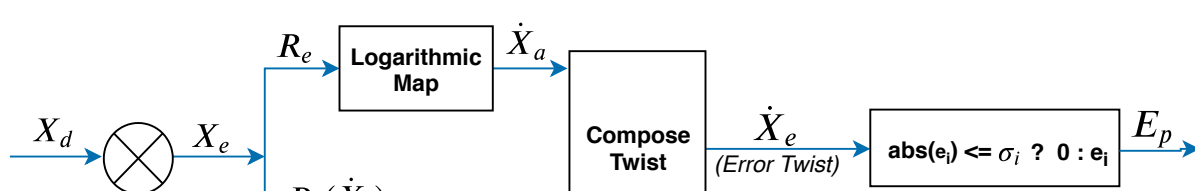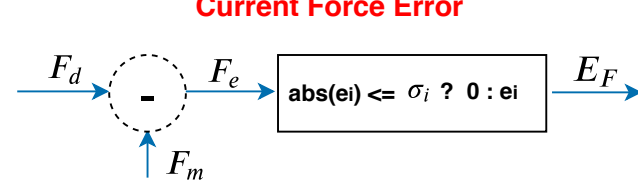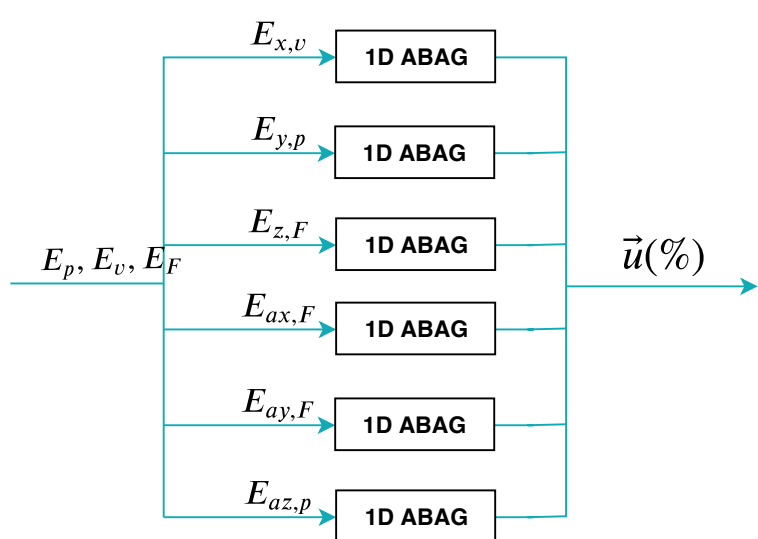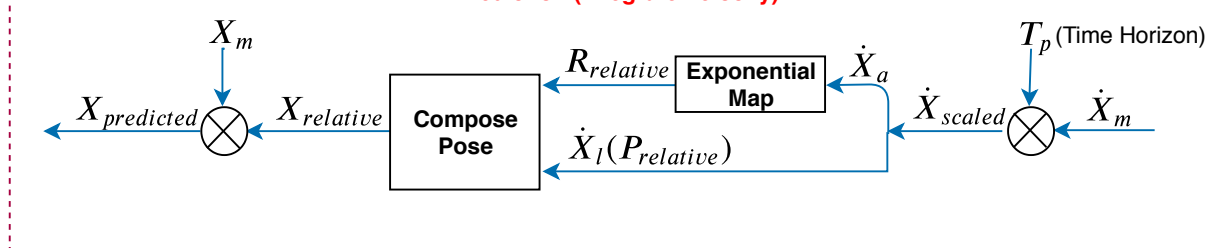
Example of **moveConstrained follow path** task definition

move compliantly { // *with task frame directions*

     * X_T: velocity motion profile (tube 0.01 m/s)
     * Y_T: position tube 0.03 m
     * Z_T: force profile (tube 0.5 N), position tube 0.03m
     * aX_T: force 0 N, tube 0.1 N
     * aY_T: force 0 N, tube 0.1 N
     * aZ_T: no specs / orientation tube 10 deg

} until: * distance in X > d m
            * F_x/F_y > 0.5 N
            * time > 20 sec

Objective (Error) function

Monitors (FSM)

FSM For **moveConstrained** force and path following task

START → Initialize → NO_MOTION (STOP)
STOP ← Timeout

NO_MOTION (STOP): Whole Tube Covered / Contact Detected
Contact Detected
Tube Not Covered

Tube Following:
CRUISE_THROUGH_TUBE
CHANGE_TUBE_SECTION
Tube Section Covered
Tube Section Changed
Out Of Tube (Disturbance Occurred)

START_TO_CRUISE
Inside Tube