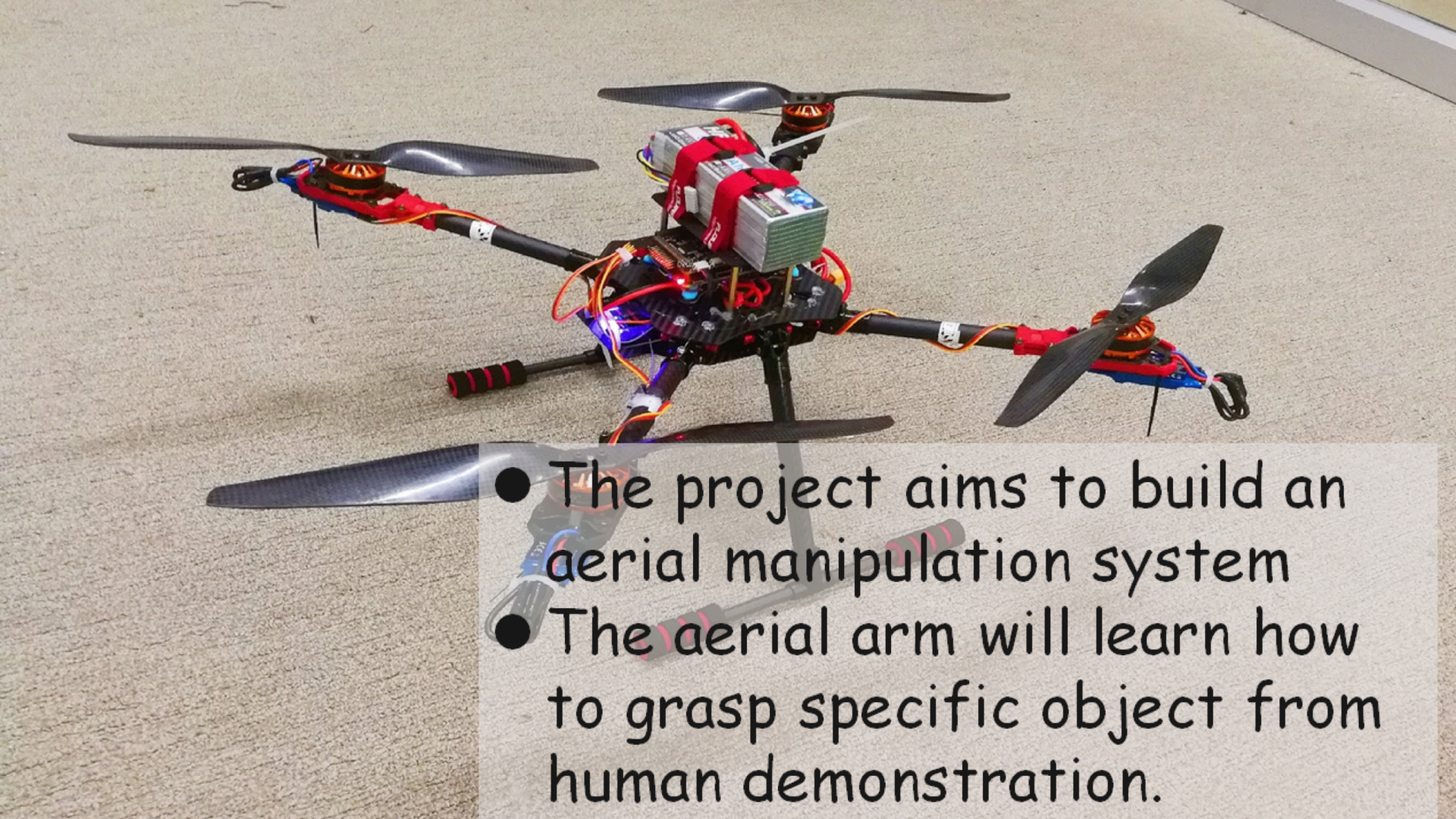


- The project aims to build an aerial manipulation system
- The aerial arm will learn how to grasp specific object from human demonstration.

Research Question

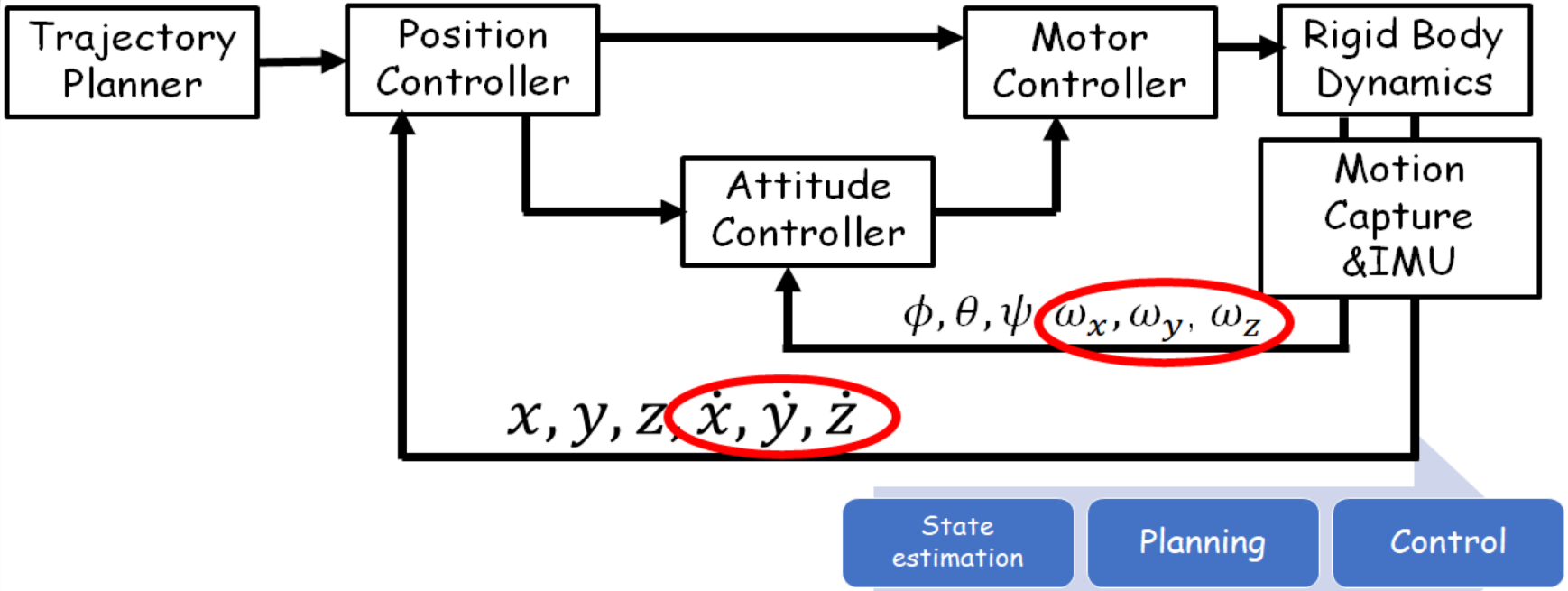
We are trying to build intelligent Unmanned Aerial Manipulator, interacting and cooperating with users to accomplish general daily tasks.

Platform Design

Learning Framework offline+online

Efficient model learning from Joint- Action demonstration


NAVIO2
HRB 5000


Trajectory Planner
Position Controller
Motor Controller
Rigid Body Dynamics
Attitude Controller
Motion Capture &IMU
ϕ, θ, ψ $\omega_x, \omega_y, \omega_z$
$x, y, z, \dot{x}, \dot{y}, \dot{z}$
State estimation
Planning
Control

16 states Extended Kalman Filter is derived based on kinematic model for state estimation.

Extended Kalman Filter

- time update

$$\bar{x}_{t+1} = f(\bar{x}_t, u_t, 0)$$
$$\Sigma_{t+1} = F_t \Sigma_t F_t^\mathsf{T} + W_t Q W_t^\mathsf{T}$$

- observation update

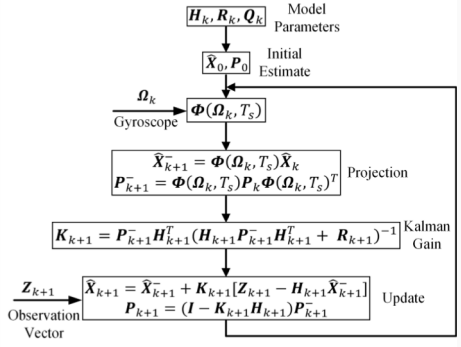
$$\bar{x}_{t^+} = \bar{x}_{t^-} + \Sigma_{t^-} H_t^\mathsf{T} \left(H_t \Sigma_{t^-} H_t^\mathsf{T} + R \right)^{-1} (y_t - h(\bar{x}_{t^-}, 0))$$
$$\Sigma_{t^+} = \Sigma_{t^-} - \Sigma_{t^-} H_t^\mathsf{T} \left(H_t \Sigma_{t^-} H_t^\mathsf{T} + R \right)^{-1} H_t \Sigma_{t^-}$$

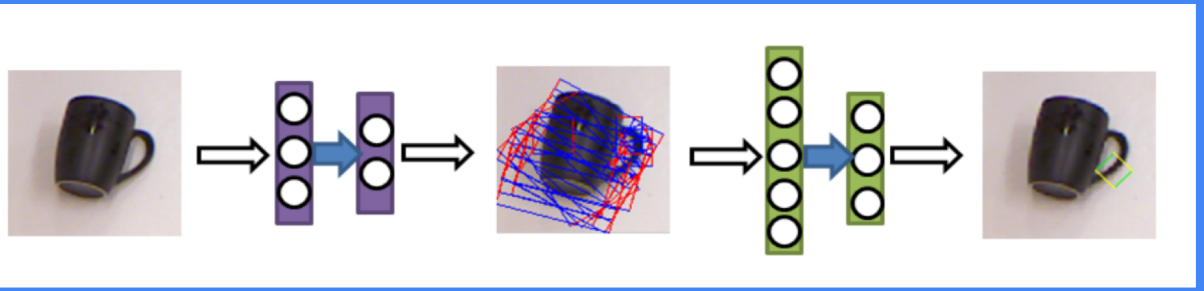
$$\tilde{x}_{t+1} \approx F_t \tilde{x}_t + W_t w_t$$

$$F_{ij} = \frac{\partial f_i}{\partial x_j}(x_t, u_t, 0), \quad W_{ij} = \frac{\partial f_i}{\partial w_j}(x_t, u_t, 0)$$

$$\tilde{y}_t \approx H_t \tilde{x}_t + V_t v_t$$

$$H_{ij} = \frac{\partial h_i}{\partial x_j}(x_t, 0), \quad V_{ij} = \frac{\partial h_i}{\partial v_j}(x_t, 0)$$





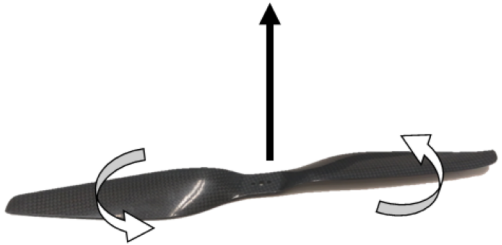
Finish debugging state estimation code.

Derive dynamic model of quadcopter

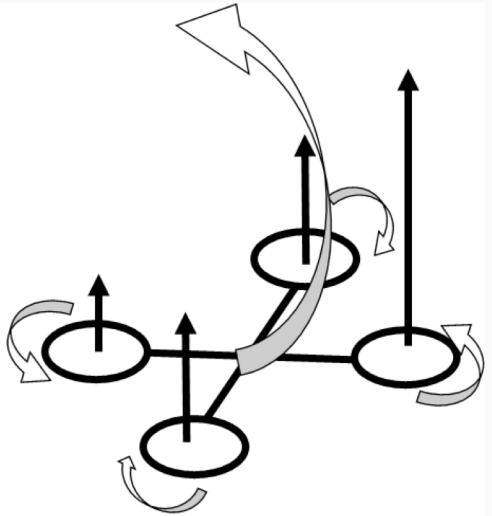
Software for control

Training offline model with force information

RL for IKsolver



$rpm, F_{thrust}, l_{propeller}$



$F_1, F_2, F_3, F_4, \phi, \theta, \psi$

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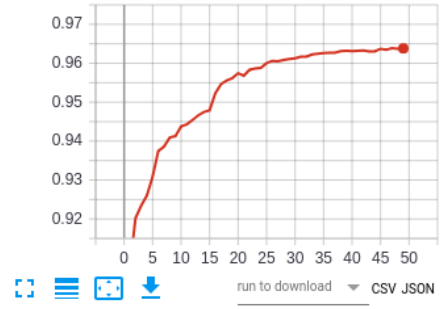
tag: scalar/scalars_tacc



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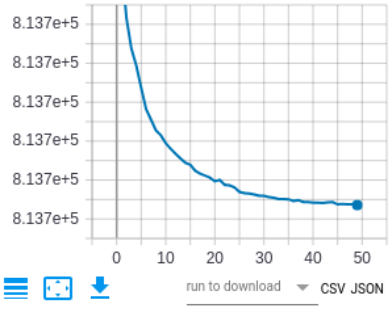

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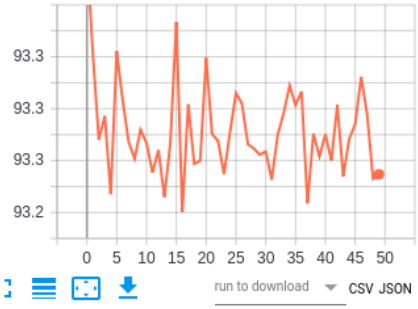

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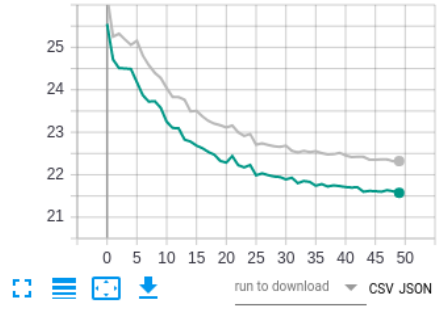

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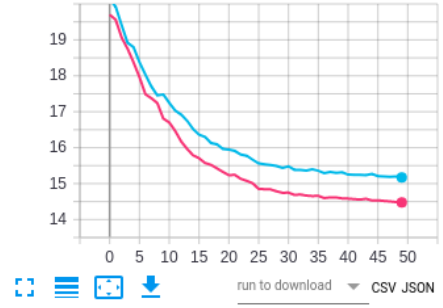

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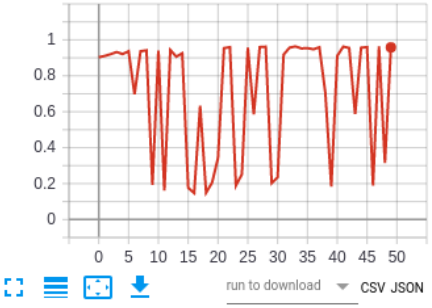

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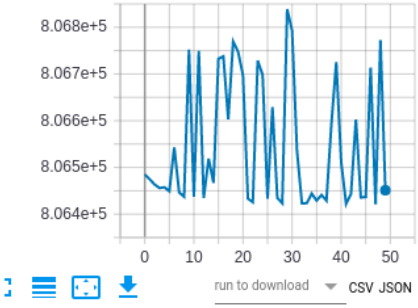

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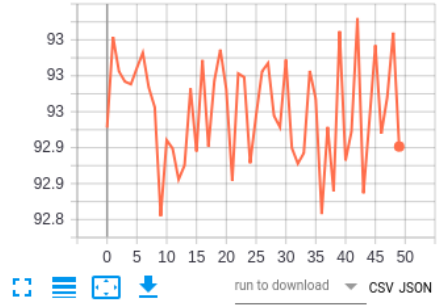

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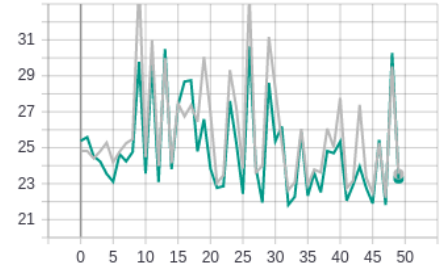

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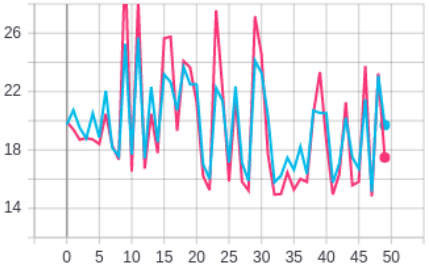

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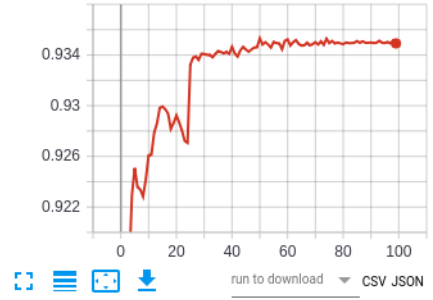

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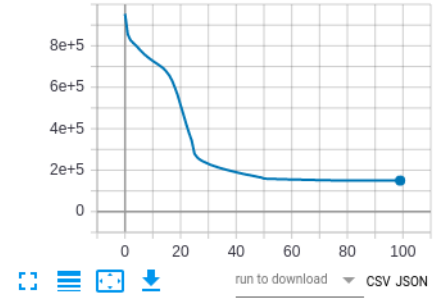

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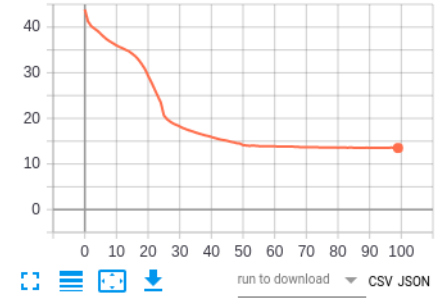

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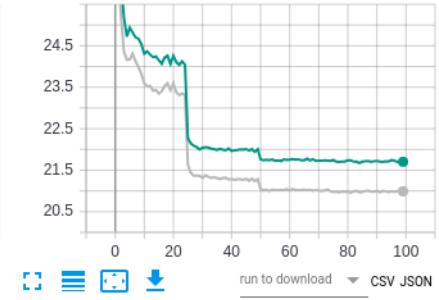

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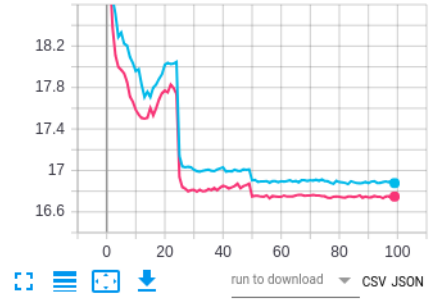

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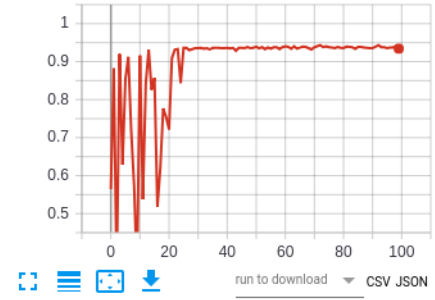

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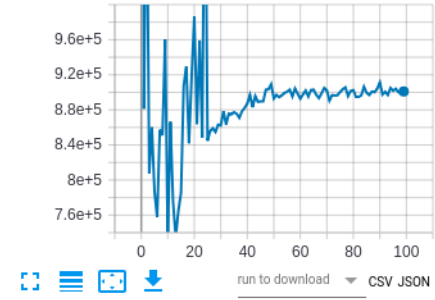

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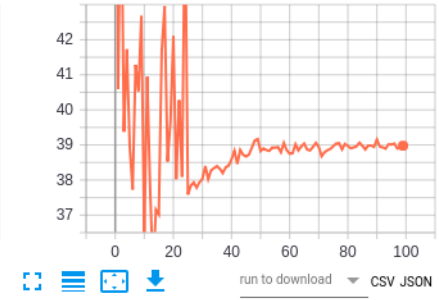

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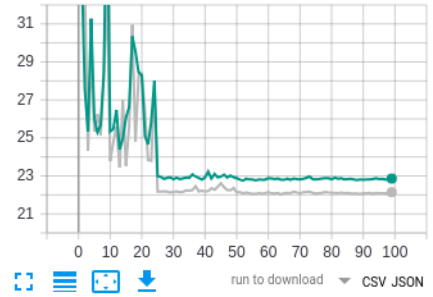

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