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     2. Stabilization step: PP (without integrator)

**EXPERIMENTS**

1. Problem statement
2. Model description:
   * **Parameters estimation experiments: inertias, friction coefficients, torsional spring** ✔️ (old slides)
   * **Model validation experiment** ✔️ (old slides)
   * **Simulator design (screens)**
3. State estimation techniques: filtered derivative, Kalman filter, Sgolai filter (one experiment to compare):
   * **Comparison a-posteriori on model validation experiment­­­❌(3 exps in simulation)**
4. Position control (downright position):
   * *Control requirements*
   * PD / PID:
     1. **PD validation** ✔️
     2. **PID validation** ✔️
   * *State-feedback controller (with focus on minimization of alpha oscillation)*
   * Pole Placement (with/without integrator):
     1. **PP validation:**
        + **Static exp high performance polyfit** ✔️ (PP\_down\_0\_static)
        + **Static exp low chattering polyfit ❌ (c’è senza polyfit (1), K\_pp\_al\_th\_0\_2)**
        + **Dynamic exp high performance polyfit** ✔️ (PP\_down\_1\_[polyfit] FAKE o PP\_down\_0)
        + **Simulation for chattering motivation ❌ (simulation)**
        + **Dynamic exp low chattering polyfit** ✔️ (PP\_down\_2\_polyfit\_2\_120)
     2. **PP + Integrator validation (+ discorso tuning integratore mastro magheggio)** ✔️ (PP\_int\_down\_3 HP, PP\_int\_down\_2\_polyfit LP)
   * LQ (with/without integrator):
     1. **LQ validation** ✔️ (LQ\_down\_2 HP, LQ\_down\_4\_polyfit LP)
     2. **LQ + Integrator validation** ✔️ (LQ\_int\_down\_7 HP, **❌** LQ\_int\_down LP (1), K\_LQ\_int\_down8)
5. Stabilization of upright position (fake tracking, theta fucks, I care about alpha ass):
   * *Control requirements*
   * PP without integrator:
     1. **PP validation + abuse ❌** (PP\_complete \_up\_3 RUOTA DI SCORTA , da fare, nice to have(4))
   * LQ without integrator
     1. **LQ validation + abuse**  **❌** (da fare, nice to have(4), abbiamo gain)
6. Position control (upright position):
   * *Control requirements*
   * PP (with integrator):
     1. **PP + Integrator validation** ✔️ (PP\_int \_up\_3 HP, eventuale HP con int magheggiato K\_pp\_al\_th\_pi\_int\_7 (3), manca LP K\_pp\_al\_th\_pi\_int\_8 (2))
   * LQ (with integrator):
     1. **LQ + Integrator validation** ✔️ **(LQ\_int\_up\_2 HP, LQ\_int\_up\_2 HP con int dimezzato PARA K\_LQ\_int\_up3 (3), (LQ\_int\_up\_2\_polyfit HP), LQ\_int\_up\_2\_polyfit con Tass maggiore LP K\_LQ\_int\_up4 (2))**
7. Swing up:
   * *Control requirements*
   * Double Switch controller **(+ VIDEO in presentazione):**
     1. Swing up step: bang-bang controller, Lyapunov:
        + **Bang-bang controller validation** ✔️ (new\_swing\_up\_down\_int, to be wrapped/shaped)
        + **Lyapunov controller validation ❌ (trust in God (1))**
     2. Stabilization step: PP (without integrator):
        + **Overall controller validation (for the best performing swing up step)**

**For every experiment is needed (possibly on the same plot to save space):**

* **Simulation test (+ Bode)**
* **Real setup test (+ Bode)**