Key Terms with Tuning

Error

- The difference between 2 lines (i.e. Position & Reference or Velocity & ReferenceSlope)

Gain

- Tuned values such as kP, kS, or kV

Binary Search

- The process of finding an accurate gain while tuning
  - Start at 1 and keep on doubling until it is too much (e.g. 1 ➔ 2 ➔ 4 ➔ 8 ➔ 16)
  - Once it is too high, take the average of the current number, and the previous number (16 is too high, so the avg of 16 & 8 is 12, so try that)
  - Then, you have to make a choice for what to do next:
    - If this new number (12) is still too much, take the avg of the current number and the previous number which was still under the target (the avg of 12 and 8 is 10, so try that)
    - If this new number (12) is too low now, take the avg of the current number and the next higher number which was over the target (the avg of 12 and 16 is 14, so try that)
  - Repeat this decision over and over until you find the number that is a good match for the target

Closed-Loop Control

- Uses tuned gains to go to a set position or reach a certain velocity
- Usually relies on a sensor, such as the inbuilt encoder on the TalonFX or an external CANcoder to minimize error
- Consistent and accurate results
- Used for arms, flywheels, or pivot
- Examples: MotionMagicTorqueCurrentFOC, Position Voltage, VelocityTorqueCurrentFOC

Open-Loop Control

- Just spins a motor using just power
- Relies on timeouts or conditions, not sensors
- Used for intake or indexer
- Examples: DutyCycleOut, VoltageOut

kP

- The larger the difference between the current and target positions, the more power it puts to the motor to reduce the error
- Typically will cause some oscillation

kI

- If there is a consistent error between 2 lines, this gain will gradually reduce the difference between them

kD

- Resists change in movement of the motor
- This gain helps to dampen the effects of kP, reducing egregious amounts of oscillation

kS

- The 'S' stands for Static Friction
- The amount of extra force needed when the motor starts moving to combat the Static Friction

kV

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kA

- This gain increases the acceleration of the motor
- This makes something like the *Position* line steeper the more it's increased

kG

- This is the amount of extra force the motor needs to combat the force of gravity
- This is especially important in an elevator to make sure it keeps its vertical position

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