

What's an “Axis Object”?

- Common ancestor for all motor and thermal control objects
 - Almost all the ESP Ruby TLAs inherit behaviours from axes
- Axes are typically defined in `configure.rb`
 - Or in `preconfig.rb` or `postconfig.rb`
 - Always as superclasses (Syringe, Slide, etc.)
- May be added or removed “on the fly”
- Base class is technically “AxisKernel”
 - Axis class inherits from that, adding an AxisMap



AxisMaps

- Simply map named positions to raw, numeric positions
 - Raw positions required for hardware control
 - Named positions much easier for people to understand
 - Also isolate protocol scripts from hardware changes
- Multiple names can be associated with each numeric raw position
 - The first name is the position's “label”
 - The reverse mapping always uses this “label”
 - Others are aliases



Common AxisMap behaviours

- Reverse map raw position to named position
 - Determine if raw position is near enough named position to be considered “at” the position
- Create a position exactly between two named positions
- Advance to the next named position (or “detent”)
 - Retard to the previous one
 - It's also possible to advance/retard by a decimal number of positions (or detents)
 - This is complicated when the spacing between them is not equal
- There are a few more operations defined in axis.rb



Slide Objects

- Most basic LinearAxis of all the ESP TLAs
- Clamps are Slide axes
 - Think of Slide trombones :-)
 - Not meaningful to talk about units of movement between defined positions or detents (or musical notes :-)
- No notion of empty or full
- However, one can specify movement to a point exactly “between” to defined positions.



Scale Objects

- Scale objects are Slides with notion of measurement units
- Simply some number of raw counts equal 1 logical unit
 - Most be linear across entire range
- Units can be arbitrarily named
 - Call them ml, ul, or “pucks”, degrees C
- Adds notion of a zero point
 - Raw count where number of logical units equals zero.
- Adds notion of a skew
 - With linearly interpolated best fit for empirical measurements
 - Used only for Thermal objects in practice



Pump Objects

- Pumps are slides with some linear mapping between rawPosition and logical (typically volumetric) units.
- Pumps have no notion of “emptiness” or “fullness”
- Just a constant, prescribed of countsPerUnit



Syringe Objects

- Syringe objects are Slides with measurement units and notion of emptiness and fullness
 - Typically volumetric units
- Adds push and pull methods
 - To move relatively a specified number of logical units



Shaft Objects

- Most basic RotaryAxis object – analogous to a circular Slide object
- Adds dial and dialBetween methods
 - _ dial to an exact position
 - _ dialBetween to predefined positions
- Dial methods usually choose shortest route around circle
 - _ However, one can specify :via some position
 - Xyz.dial :nastyStuff, :via=>:flushFluid
 - _ Or, :avoiding some other position
 - Xyz.dial :waste, :avoiding=>:air
 - _ But not both :via and :avoiding in the same motion
- Shafts may also be advanced or retarded by a number “detents”
 - _ Advance 1 goes to the next position, Retard 1 goes to the previous position
 - _ Abc.retard -1.5 moves 1 ½ positions **forward**
- All Rotary Valves are Shaft Objects



Solenoid Objects

- Inherits from AxisKernel – not Axis
 - Because solenoids have no notion of position between there endpoints
 - So there's no concept of rawPosition or an AxisMap
- Each has exactly two named positions
 - Or “states”
- Not usually used directly
 - See Valve Objects instead



Valve Objects

- Solenoid Valves with provision for aliased position names
- Valves are always Solenoids – not rotary valves
 - Which are Shaft objects



Valve::Manifold Objects

- Valve::Manifold is an array of Valves
 - At most one valve is “selected” or opened at any time
 - If no valves opened manifold is said to be “bypassed”
 - In which case it reports its state as :bypassed
- New feature is ability to “alias” the names of the valves themselves within the Valve::Manifold array
 - This is inherently different than aliasing position names
 - But works the same way because users think of the Manifold as one integrated valve.
- It is possible to access individual Valves in a manifold directly



Thermal Objects

- Thermal Objects are Scales
 - With very different underlying hardware!
- The same methods that work on Scales also work on Thermal heaters.
- Uses Scale::Skews to define a mapping between rawTemperature (ADC counts) and logical degrees C
 - That changes depending on ambient temperature
- PID controller is very different at dwarf firmware level
 - P,I,D are augmented by addition damping factors

