Assignment 12

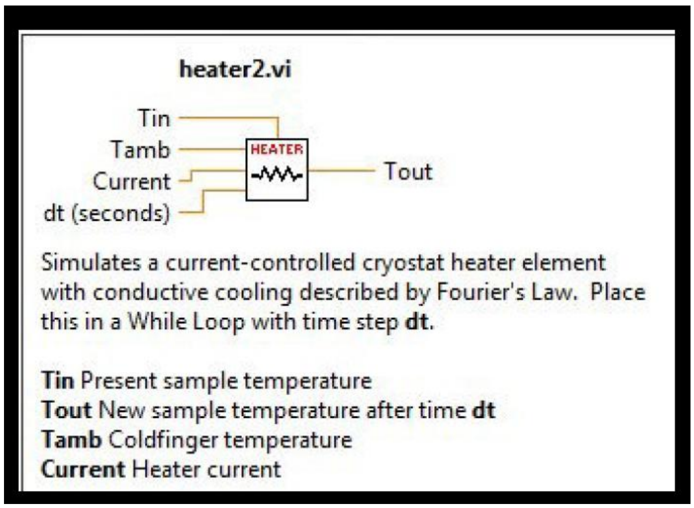
(Due Monday 21 November)

Thermostat

Download the subVI named heater2.vi from the class website and place it inside a While Loop. This subVI simulates operation of a temperature-controlled cryostat (see Lecture 12 slides). Heat is removed from the sample by conductive transport to a low temperature reservoir such as a pool of liquid nitrogen. Heat is introduced by flowing DC current (*I*) through a thin wire of resistance *R*.

Power is dissipated in the wire according to Ohm's Law (I^2R) with temperature increase due to Joule heating. The sample temperature is at the instantaneous balance point between heating and cooling.

The terminals of this subVI are defined as follows:

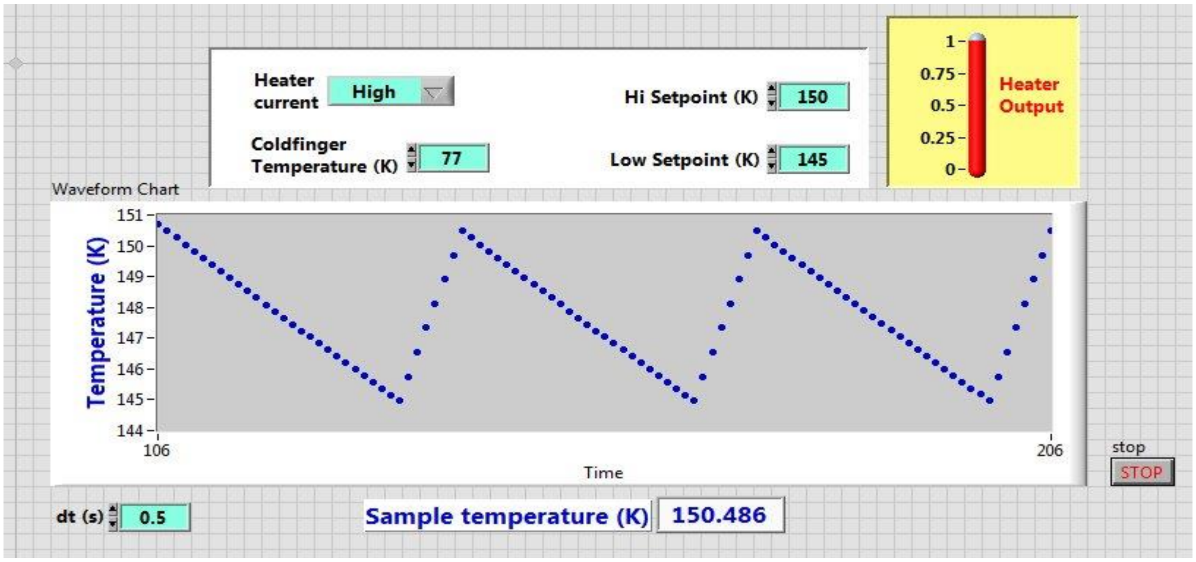


Tamb is the reservoir temperature, which is 77K for liquid nitrogen. **Tin** and **Tout** are the input and output temperatures, respectively; wire these to the corresponding terminals of a shift-register. The time **dt** is also the Wait time of the While Loop (note that the subVI requires *s* not *ms*).

Current is supplied by a heater control with three selectable levels: 0.1 (Low), 0.5 (Medium), and High (1.0). Select these using a ring control on the Front Panel. On the Block Diagram wire this control to a Case Structure and place the three different level constants there. Connect this heater control to the **Current** terminal of the subVI. Add a Front Panel indicator to monitor what the heater is doing.

In a thermostat, the heater is either on or off (i.e. Boolean T/F), but there must be some hysteresis. This is implemented with high and low temperature setpoints: When temperature is below the Low Setpoint, the heater turns on (State 1). When the temperature is above the High Setpoint the heater is always off (State 4). You must develop logic for when the temperature is between the two setpoints (States 2 and 3). It is in this range that the hysteresis is implemented. A state machine is one possible approach among several, but the hysteresis can be simply handled by monitoring the state of the Boolean T/F that is driving the heater. Pass this Boolean to subsequent loops with a shift-register. State 2 or 3 is determined by examining the heater Boolean when the temperature enters the range between the setpoints. This can be done with two comparisons and two Select functions. Coding the hysteresis is, however, entirely at the discretion of the programmer. The only imperative is that you have a Boolean T/F heater control that will eventually get wired into Elvis board.

Display the real-time temperature (**Tout**) with a numerical indicator and Waveform Chart. A representative Front Panel can look like this:



In the next lab, this assigned VI will be interfaced to the Elvis board to control the temperature of a tiny "oven".