1 Introduction

One aspect of the problem at hand is to understand the time length of an "episode," a complete cycle of events. There exists several artificially-imposed time lengths on the system: the cycle, currently 1 second, and the supercycle, currently 60 $\frac{1}{15}$ seconds. Both are subject to change, and samples are drawn at a frequency of 15 Hz, so that a cycle yields 15 observations and a supercycle 901. There are natural time-lengths to consider as well: a year, a month, a day, an hour, a minute. The purpose of this memo is to discuss the advantages and disadvantages of defining an episode according to particular time lengths. We find that **one second** is the best choice for now in terms of richness of samples and quantity of data.

2 Time Lengths

2.1 Cycles

The first choices to address are the time lengths associated with the system itself. In this section, we consider using the cycle or the supercycle.

A cycle consists of 15 samples, yielding a large amount of data to train on. However, the main controller, the TLG, operates on the supercycle; it details a list of actions to occur within the supercycle, and that theoretically can change with each new supercycle. From analysis of the TLG supercycles, the cycles within differ, but the system is periodic with respect to the supercycle. Using the cycle would be nice insofar as we would have different episodes playing out, and we can use the data to see how different cycles affect the system. While there's low sampling amount, there's a large amount of samples to draw from. That is, there are many different cycles, and this richness may allow us to learn better.

A supercycle consists of 901 samples, and is largely periodic; from data drawn over different hours, it seems the supercycle remains fairly constant. For this reason, using the supercycle as an episode is actually disadvantageous. With the same episode being repeated again and again, and different observations resulting from the same epside, there's not a clear path to learn the relationship between episodes and observations. While supercycles may seem to be a natural definition for an episode, it may be the weakest in terms of learning capability.

From this brief discussion, one can draw the conclusion that indeed a cycle would be more powerful as an episode than a supercycle. One thing to note is the cyclic nature of the supercycle; thankfully, it is just off 1 second, so that we may obtain different event sequences per episode, but if a supercycle is ever defined as an integer multiple of a cycle, then we lose the power of using the cycle as an epsiode.

2.2 Natural Times

Another consideration for defining an episode is to use natural times– an hour, a day, etc. The only connection to the supercycles and cycles is by conversion of units in time; people work on the accelerator around-the-clock, and minor changes, if any, are made on the fly. We may still consider the benefits of using natural time.

Using a single hour or minute as an epsiode time length would bin 3600 cycles or 60 cycles into one episode. By binning the data into these blocks, we lose some of the richness that can be extracted from using a single cycle as an episode. Supercycles seem to largely be periodic, and even by binning according to that time length, we've already noted how we lose the richness of information – the inputs, the events, are largely constant. The nice thing about an hour or a minute would be that supercycles would have an extra sample associated with these time lengths. With that extra component, we may be able to learn based on the one different operator per episode. A minute would allow sixty more episodes, as well, and effectively sixty more samples of different events. Binning by an hour or a minute has its strengths, and perhaps the minute is the strongest of the two.

Lastly, we consider longer time lengths– weeks or months. Binning by weeks or months could allow a very rich and strong basis to understand seasonal changes in the machine. However, data is only saved on approximately a 10-day basis; that is, after 10 days the system parameters, observations, etc are all flushed. We began extracting a subset of the data a few weeks ago, so perhaps this kind of time series analysis can be considered in the future, but for now we do not have enough data to understand this problem.

Using a second as an episode length has all the advantages of using a cycle as an epsiode. Indeed, for now, this time length seems to be optimal in allowing richness of episodes and quantity of samples.

3 Conclusions

In this memo, we discuss differing definitions for an episode based on the system and natural time lengths. One can conclude from these discussions that one second is the appropriate and best choice for now.