Scheduling Automated Telescopes

G.E. Miller (CSC) and M.D. Johnston (STScI)

Two attributes characterize the scheduling of an automated telescope: the capability to independently execute a schedule of observations and the ability to modify this schedule in response to changes in observing conditions (e.g. to substitute a less demanding observation in the event of poor atmospheric seeing, or to perform detailed observations when a supernova is discovered in a search). Examples of telescopes which will be to some degree automated include the Hubble Space Telescope, the Texas-Penn State Spectroscopic Survey Telescope and the European Very Large Telescope; future telescopes are likely to be even more automated. Automated telescopes present several challenging problems for planning and scheduling.

At the STScI, we are developing a general, flexible planning and scheduling system (Spike) which is suitable for long and short term planning. This software is based on "artificial intelligence" technology. We have developed a general means to represent constraints, including uncertainty and human judgement values, and to propagate the effect of constraints on other observations. A graphically oriented scheduling workstation allows a planner to view a timeline and commit observations to the schedule. This system permits planners to gain insight into the scheduling constraints and the effects of scheduling decisions. Schedules can be produced automatically using several methods, including procedural algorithms, rule based expert systems, neural networks and genetic algorithms. Current work has focused primarily on the long term planning problem. Spike is presently being used to schedule observations for the Hubble Space Telescope and has been demonstrated on representative scheduling problems for several other observatories. We note that instrument characteristics (warmup times, calibrations, commanding) can have a substantial influence on the scheduling problem and should be carefully considered in the design of an observatory.