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Development of target allocation methods for LAMOST focal plate

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Abstract. We first introduce the primary target allocation requirements and restrictions for the parallel control multiple fiber system, which is used in the LAMOST spectroscopic survey. The fiber positioner anti-collision model is imported. Then several target allocation methods and features are discussed in detail, including a network flow algorithm, high priority for fiber unit holding less target number, target allocation algorithm for groups, target allocation method for add-ons and target reallocation. Their virtues and weaknesses are analyzed for various kinds of scientific research situations. Furthermore an optimization concept using the Simulate Anneal Arithmetic (SAA) is developed to improve the fiber utilizing efficiency.

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Characteristics of the focal plate: (1) the even distribution of fibers in the whole focal plate. (2) Physical interference of adjacent fiber positioners. (3) Blind regions in the focal plane caused by four guide CCDs, center SH CCD and other abnormal fiber cell.

Requirements: (1) Given the input catalog in tile, assign as more targets as possible. (2) Evenly assign some skylights and flux calibration stars for each plate and clip. (3) Object priority, status and magnitude (4) Target group consideration.

Methods: The basic steps of the allocation include calibration star allocation, target allocation, skylight allocation and add-ons allocation, taking the object locations, fiber interference, priority and expected allocation number into account. Several allocation strategies are developed with specific features. The method GroupAllocationStrategy can divide targets into several groups and tag each group with a group PRI and an expected group allocation number. The method NLayerPriorityAllocationStrategy chooses target from the priority ordered queue firstly and then tries to allocate the chosen one to the fiber cell with the least number of covered targets because it may have no other options. Oppositely the method NLayerNoPriAllocationStrategy chooses the fiber cell with the least number of covered targets firstly and then searches a target in the chosen fiber cell. In addition, the Simulate Anneal Arithmetic (SAA) idea can also be used to improve the allocation number by iteratively reallocating these allocated fiber cells.

Results: (1) A high fiber allocation ratio needs an input catalogue with at least 350 targets per square degree. It is suggested that the number of targets in tile is twice the number of fiber cells. Alternative manner is to provide targets evenly distributed in arc minute scale. (2) The optimized method can improve the fiber allocation ratio by $2\% \sim 5\%$. (3) Method ignoring user PRI can improves the allocation ratio by $1\% \sim 2\%$.

Reference

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