

MEMORANDUM

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To: Roger Brissenden

From: Michael Garcia

Subject: White Paper on AXAF Star Selection Algorithm Ops
Concept

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This white paper is written in response to a RID on the ASC CDR documents raised by Allyn Tennant, RID number 053. The RID raises the concern that the implementation of the AXAF Guide/Acquisition Star Selection Algorithm (SSA) at the ASC: 1) Duplicates the implementation in the OFLS, and 2) Does not provide the ability to find stars when the OFLS system fails.

This RID was "Accepted per Comments"; the comments are outlined in this white paper. As pointed out by Allyn, much of the confusion would be clarified by outlining an Operations Concept, and therefore this memo starts off with that. Note that implementation of the SSA in the OFLS and at the ASC/DS is strongly effected by this Operation Concept for FOT/OCC and ASC/MP interaction as regards the SSA.

1 Operations Concept

Under routine operations, the SSA as implemented in the OFLS will be run by the OCC/FOT in order to select stars for acquisition and guiding. Under exceptional circumstances, the stars will be selected by the ASC/MP(SOT) team, and the OCC/FOT will check the stars

(with the OFLS) to ensure that they meet minimum requirements for the safe operation of AXAF.

The ASC anticipates that $\gtrsim 90\%$ of all operations will be routine. Analysis of the design of the AXAF Guide Star Camera Assembly (ACA) by TRW shows that five stars can be selected that satisfy the pointing/stability requirements of AXAF $\sim 95\%$ of the time. ASC analysis of the SSA confirms the TRW results. The ASC anticipates that some small fraction of observations will have scientific goals which require selection of stars under a different set of criteria than those implemented in the OFLS/SSA, and therefore that $\sim 5-10\%$ of all ORs will require some ASC oversight in order to select guide/acquisition stars. This oversight may range from simply concurring with the set of stars selected by the OCC/FOT (even though they do not meet the most stringent pointing/stability requirements), to choosing an entirely new set of stars using different criteria. Any new stars will be indicated in the OR fields already set aside for ASC selected guide/aspect stars.

2 Implementation in OFLS

The SSA as implemented in the OFLS, and as run routinely by the OCC/FOT, will operate in a batch processing mode requiring little or no operator intervention. Stars selected will be indicated in the Mission Schedule.

In cases where stars are selected by the ASC/MP(SOT) team, the OCC/FOT has the responsibility to check that these stars do not compromise the safety of AXAF. The OFLS should support this check.

Operation of the OFLS/SSA will be affected by the values of the SSA parameters in the ODB. Initial values for these parameters will be specified by the ASC/MP team. It is anticipated that these values will need to be updated soon after operations commence, once the behavior of the AXAF/PCAD is characterized, and also as the characteristics of the PCAD change with age. Updates will be done by the FOT, in consultation with the ASC/MP team.

The ASC/MP team will exercise the OFLS implementation of the SSA in order to ensure that the values of the SSA parameters are "optimal". Choices of the optimal parameters must involve a compromise between the "best" set of stars and smooth (robust) operation of the OFLS/SSA.

3 Implementation in ASC/DS

The Algorithm for selecting stars, as outlined in the ASC Document “TIM MRG.95101”, is optimal, and therefore it stands to reason that the same algorithm will be used at the OCC/OFLS and at the ASC/DS. However, the way in which the algorithm is implemented will be quite different. The SSA as implemented in the ASC/DS must support the $\sim 5-10\%$ exceptional cases requiring non-routine operations. This implies that the ASC/DS implementation must support highly interactive processing, as opposed to the batch processing of the OFLS. As part of this interactive mode, the ASC/DS version must connect seamlessly to other parts of the ASC/DS, most importantly the Visualization Tool and the Aspect Simulator.

In the tests of the SSA done at the ASC, it has been found that exceptional cases can be handled by varying the parameters of the SSA. However, scientific oversight is required in order to assess which parameters to vary, and selection of a new set of stars is greatly aided by a visualizer which shows the sky field and instrument configuration. Selection will also be aided by using the ASC Aspect Simulator. For example, one might vary the number of FID lights and guide stars, or vary the allowable quality codes on the guide stars. Depending upon the scientific goals of the observation, one of these options is likely to be more desirable than the other. There are ~ 100 different parameters one might consider varying.

Stars selected by the ASC-MP team using the ASC/DS version of the SSA will be indicated in the appropriate fields of the ORs, either before or during the mission schedule concurrence process.

The ASC does not anticipate that the SSA as implemented at the ASC/DS and in the OFLS will select identical stars after the first stages of implementation, because that the two implementations will likely diverge with time. Testing at the ASC has shown that the best set of stars identified by the SSA is very sensitive to the input parameters, and it is conceivable that minute differences in the parameters will result in a different set of best stars. However, the differences in the FOM of such sets of stars should be negligible, so either set would be acceptable.

As we gain more insight into the operation of AXAF, it is reasonably likely that the ASC will experiment with new algorithms for selecting stars which take advantage of unanticipated characteristics of AXAF operations. Testing of any new, experimental algorithms is most easily done by the ASC/SOT, through the OR fields for guide stars. If such testing reveals a new algorithm that is superior to the existing one, then the new algorithm should be considered for implementation in the OFLS.