MATCH CRITERIA FOR AUTOMATIC ALIGNMENT OF NORMAL ASTROGRAPH AND SCHMIDT PLATE

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ABSTRACT. The objective of the present study is to clarify the tests, checks and clues one may employ to determine whether a feature on a one century old plate is *probably identical* to a feature on a recent Schmidt plate. A test region of $40' \times 40'$ around star HD 42088 was selected in order to detect a variability in nebulosities around Gem OB 1 stars.

INTRODUCTION

Exact matching between two digitized files of the same sky area is not always possible. The inventory of two separate scans of one plate does not even provide a complete matching. One needs therefore to develop relative or probabilistic measures of matching in order to achieve some degree of comparison of alternative fittings, especially in the case of the study of plates exposed at different epochs through different cameras.

TEST MATERIAL

An area of $40' \times 40'$ containing large diffuse nebulosities was selected in order to determine the tangential velocity of the shock front at the edges of the giant molecular cloud and the H II regions in S 252 (NGC 2175). Since the scientific goal is to segregate tangential velocities for star and gas content, particularly for Gem I association OB members at 2 kpc, a comparison is performed through a matching process of digitized files from pixel to pixel.

A set of three photographic plates was scanned and inventoried at the Automatic Plate Scanner of Minnesota University (Humphreys, 1987) :

- deep plate exposed on 1887 February 21 by Henry folks at Paris Normal Astrograph
- 1955 POSS plate copy
- CERGA Schmidt plate exposed in 1982

With an assumption of 100 km/s for the shock front velocity of the H II region at 2 kpc, apparent displacements of 1 arcsec should be noticed on the measured plate material which spans almost one century.

S. Débarbat et al. (eds.), Mapping the Sky, 207–210.

ALIGNMENT PROCEDURE

The most common procedure is to overlay the map produced directly from digital scans onto each other. One then continues by aligning all maps by pairing several star features of all maps, then by stretching the maps so that the paired star features are aligned. The whole point of this procedure is not to alter the relative positions, since the plate coordinates of obviously identical objects are aligned, and then to identify more readily additional matching features such as nebulosities. This approach for matching map features through alignment is essentially iterative on different plate subsets and is very useful for the visual comparison process.

A more automatic map matching has been developed to start the present experiment attempting to match digitized scans. As a preliminary step of matching enormous numbers of linear features in a consistent and comprehensive manner to prevent duplicates and missed coverage, one starts by using the pairable points to estimate translation, rotation and scaling effects (Groth, 1986). In order not to ignore the fundamental character of the feature data (pixels at specific locations with measured densities), the study of the 3D pattern (planar position and density) has to be extended with the image properties such as orientation, size, order along boundaries. A linear programming approach by a pruned tree-search method has been developed and made use of the Soviet ellipsoid algorithm for testing feasibility of systems of linear constraints (Papadimitriou *et al*, 1982) . This framework is used easily for improved results when noise bounds (such as proper motion in coordinates) are permitted to be specified as arbitrary convex polygons about each model feature location.

ONGOING RESEARCH

A need to standardize many automated catalog processing capabilities has prompted the Stellar Data Center in Strasbourg to evaluate the systems currently using a high resolution color graphics terminal for later processing an overlay of surveys in different wavelengths. The performance of each system is being evaluated on the basis of several benchmark tests which addressed user time requirements, computer loading factors and data accuracy. The primary objective is to identify those components of data comparison systems that contribute most significantly to their ability to compile high quality astronomical data bases. Right now, limited objectives for ATLDB (Astronomical Target Location Data Base) may be summarized as follows (Fresneau, 1987) :

- improve coordinates
- establish match flags

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- establish non match flags
- create maps which highlight matches and non matches

ATLDB will be developed to meet the challenge of managing a global digital imagery data base capable of displaying star fields to the analyst to support target identification and file updating.

CONCLUSION

This paper describes the underlying theory developed to the problem of map merging procedure. Reproducibility, quality control and a desire for mathematical consistency in the algorithms lead to a need for well defined interactive procedures. A triangulation on a finite set of points leads into an efficient algorithm used for transforming the coordinates of digitized map files. The linear inequality tests used in the present study work for any constraints and is used in a prototype program. Results shown in Figure 1 identify the objects appearing on a one century old plate which do not match a POSS plate copy on an area of $40' \times 40'$.

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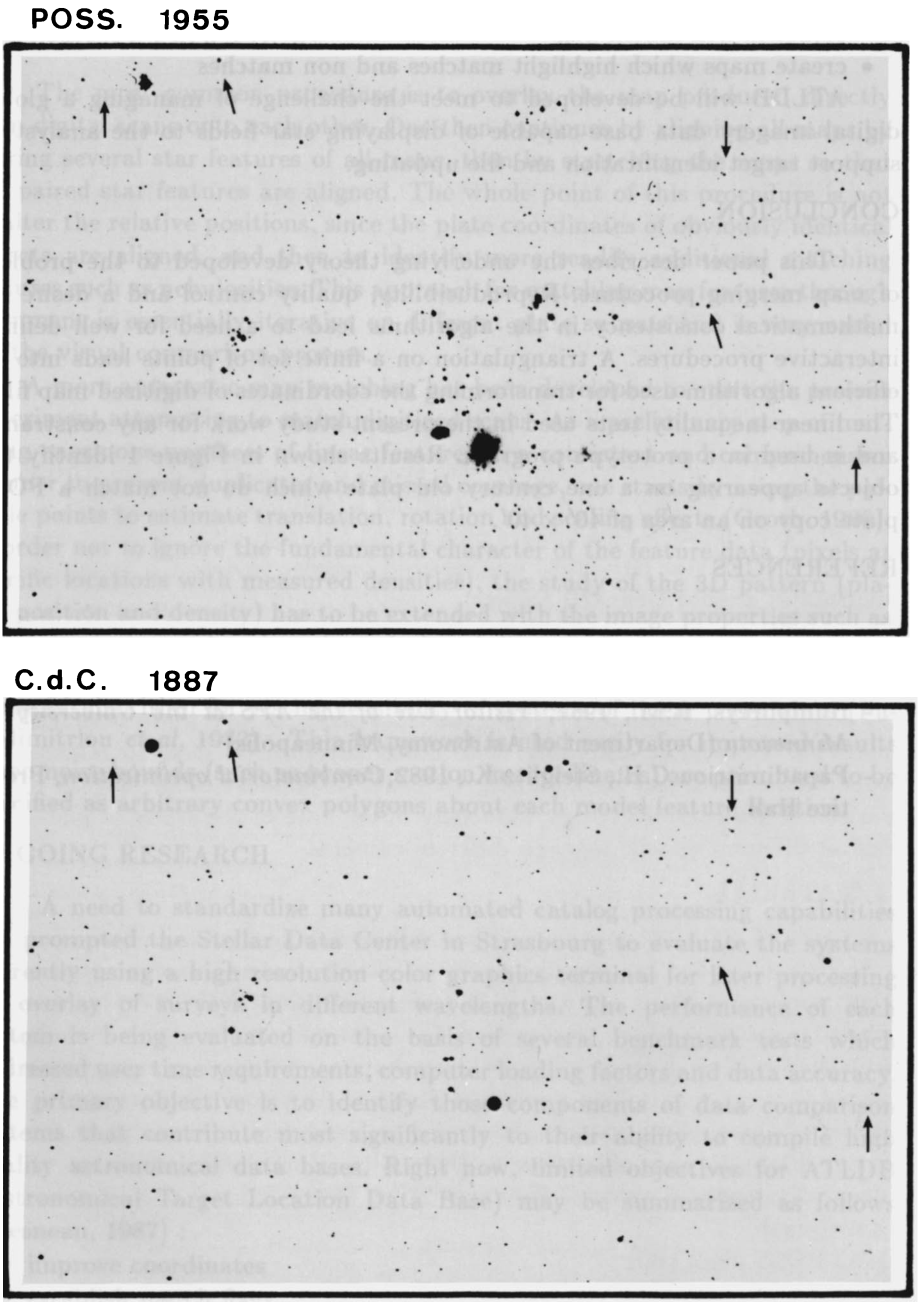

Figure 1

Detection of variable objects by matching
a one century old astrographic plate with a POSS copy

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