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Appendix: Enhancement of the SKYMAP SKY2000 Master Catalog to Produce Version 4 of SKY2000

Background

The creation in June 2000 of the SKY2000 Version 3 Master Catalog (MC) marked the complete replacement of photovisual and photographic magnitudes and Henry Draper (HD) spectral types in the SKYMAP MC. At that time, charge-coupled device star tracker (CCDST) magnitude data from the star tracker onboard the Submillimeter Wave Astronomy Satellite (SWAS) were added for approximately 700 entries lacking such data. The SKY2000 Version 3 MC included the reintroduction of data from original sources for as many fields as could be updated at that time. Other fields, such as variable star identifiers and variability data were not updated. The SKY2000 Version 4 MC marks the global replacement of the variability identifier and variability data fields. These data were drawn from the New Catalogue of Suspected Variable Stars (NSV, Reference 1), the New Catalogue of Suspected Variable Stars, Supplement (NSVS, Reference 2), the General Catalogue of Variable Stars (GCVS, Reference 3), and the 76th Namelist of Variable Stars (NL76, Reference 4). Collectively, these catalogs represent the most current assemblage of variable star identifiers and data available.

Procedure

The process of updating the variable star identifiers and variable star data fields followed a specifically selected order. First, each of the variable star source catalogs was combined with the appropriate cross-reference identifiers found in separate “crossid” files to create merged files incorporating in each data record cross-reference identifiers, positions, variable star identifiers, and variability data. The resulting merged files were then processed against the SKYMAP MC in the following order, with quality assurance checking and error correction after each step: First, the NSV was processed; second, the NSVS was processed; third, the GCVS was processed; and fourth, the NL76 catalog was processed. This order resulted in the replacement of data from a previously processed catalog by data from a newly processed catalog for a given MC entry where a particular star is found in more than one of the variable star catalogs. The result is a complete replacement of variable star identifiers and variability data with reliable, up to date data directly attributable through source codes. After the catalog processing phase was completed, two data verification programs were run, one concentrating on the variable star identifiers and the other concentrating on the variability data. Output from these programs were examined and deletions or alterations to identifiers and variability data were made where appropriate. In the case of the GCVS only (which possesses the most

complete and accurate magnitude data of the four catalogs), a file of bright and relatively bright variable stars not found in the SKYMAP MC was retained so that these stars may eventually be added to the MC.

Results

The changes to the SKY2000 MC can be summarized in terms of changes from Version 3 of SKY2000. The SKY2000 Version 4 MC contains 299,167 entries, an increase of 7 over the 299,160 entries in SKY2000 Version 3. SKY2000 Version 4 contains 12,792 entries with variable star data, as compared to 4,947 in SKY2000 Version 3. SKY2000 Version 4 contains 12,792 entries with variable star identifiers, as compared to 2,588 in Version 3. All entries with variable star identifiers also contain variability data in SKY2000 Version 4, as well as vice versa. All entries containing variable star data in SKY2000 Version 4 have defined variability type codes, with the occurrences of each type of variable star detailed in Table A-1. These type codes are described in greater detail in Table 3-5 of *SKYMAP Requirements, Functional, and Mathematical Specifications, Volume 3, Revision 3: SKYMAP SKY2000 Version 2 Master Catalog Format Specifications* (Reference 5).

The breakdown by source code of the variability data in Version 4 of SKY2000 is 6,467 from source 28 (the NSV and the NSVS), 6,276 from source 30 (the GCVS), and 49 from source 36 (Namelists of Variable Stars, including NL76), for a total of 12,792 entries with variability data. Not only has there been a large increase in the number of entries identified as variable between Versions 3 and 4, but all variability data in SKY2000 Version 4 are from primary sources (variable star catalogs), rather than indirectly through other catalogs containing variability data, as in SKY2000 Version 3. This greatly simplifies any efforts to verify variability data in the MC, and also excludes all variability data from secondary sources.

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Type Code 1: Pulsating Variable Stars							
Code	**Number**	**Code**	**Number**	**Code**	**Number**	**Code**	**Number**
1 *	146	121	25	140	128	181	5
111	110	122	19	141	5	190	118
112	9	130	9	150	407	191	66
113	22	131	6	170	45	192	54
114	8	132	4	171	1414	193	164
115	33	133	125	172	79	194	773
120	17	134	6	180	165		
Type Code 2: Eruptive Variable Stars							
Code	**Number**	**Code**	**Number**	**Code**	**Number**	**Code**	**Number**
200	52	230	4	264	161	272	2
201	11	240	1	266	1	273	171
210	214	244	8	267	6	274	17
220	24	250	7	270	23	275	16
221	1	263	1	271	30		
Type Codes 3&4: Eclipsing (3) and Rotating (4) Variable Stars							
Code	**Number**	**Code**	**Number**	**Code**	**Number**	**Code**	**Number**
300	245	330	133	430	128	461	29
310	634	410	8	440	171		
320	303	420	34	460	424		
Miscellaneous Types: Unclassified, Suspected, and Constant Variable Stars**							
Code	**Number**	**Code**	**Number**	**Code**	**Number**	**Code**	**Number**
1	2467	9	3340	10†	30	999	134

* Note: The "1 " code is used for a pulsating variable star of undefined subtype.

** Note: A "constant" variable star is a star once designated variable that has been confirmed to be constant in brightness after further study.

† Note: Code 10 is used for a few stars classified as "See GCVS 4th Edition".

Table A-1. Distribution of Variable Stars in SKY2000 Version 4 by Variability Type Code

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Conclusion

The SKY2000 Version 4 Master Catalog represents an important improvement over the SKY2000 Version 3 MC. The primary use of the SKYMAP Master Catalog is in the creation of specialized star catalogs for use by missions supporting spacecraft utilizing star sensors. Variable stars are a very important class of stars when various considerations are being weighed for the inclusion or exclusion of particular stars in a specialized catalog, such as the smaller star catalogs used onboard many spacecraft. It is very important not only to know that a particular potential guide star is variable, but also to know about the presence of any near-neighboring stars that are variable. Hence, even though a star may not be individually bright enough for inclusion in a particular specialized catalog, its presence (and variability) may affect the choice of brighter stars nearby. The SKY2000 Version 4 Master Catalog contains carefully processed variability data and identifiers that are far more complete and comprehensive than in any previous version of the SKYMAP Master Star Catalog.

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This work has made use of the Simbad database and the Aladin Interactive Sky Atlas, developed by CDS, Strasbourg, France.