Detection and measurement of double stars (L. Lindegren 78-03-10)

1. How many new double stars will be discovered by the satellite?

In an observing program with 50000 stars (systems) there will be about 35000 non-single systems (nss). I estimate that these will be distributed according to detectability etc as shown in the table below.

<table>
<thead>
<tr>
<th></th>
<th>previously known nss</th>
<th>previously not known nss</th>
<th>total</th>
</tr>
</thead>
<tbody>
<tr>
<td>detected by satellite</td>
<td>4550</td>
<td>1758</td>
<td>6308</td>
</tr>
<tr>
<td>not detected by satellite</td>
<td>1213</td>
<td>27479</td>
<td>28692</td>
</tr>
<tr>
<td>total</td>
<td>5763</td>
<td>29237</td>
<td>35000</td>
</tr>
</tbody>
</table>

These estimates are based on the following three assumptions.

A. The separation $\rho$ and magnitude difference $\Delta m$ of the secondary are distributed according to eq. (1) in my note 78-02-01, with $R_o = 0'5$.

B. The satellite detects a nss if and only if $\rho_{\min}(\Delta m) < \rho \leq 15''$, where $\rho_{\min}(\Delta m)$ is given below as function of $\Delta m$.

\[
\begin{align*}
\Delta m & \quad 0.25 & 0.75 & 1.25 & 1.75 & 2.25 & 2.75 & 3.25 & > 3.5 \\
\rho_{\min}(\Delta m) & 0.11 & 0.12 & 0.14 & 0.16 & 0.20 & 0.26 & 0.45 & \infty
\end{align*}
\]

$\rho_{\min}(\Delta m)$ is roughly 1.1 times the minimum projected separation for detection, $d_{\min}$ given in Table 2 of the note 78-02-01.

C. Present double-star catalogues contain all nss with $\rho_1(\Delta m) < \rho \leq 15''$, one half of the nss with $\rho_o(\Delta m) < \rho \leq \rho_1(\Delta m)$, and none with $\rho \leq \rho_o(\Delta m)$.

Here, $\lg \rho_1 = 0.22\Delta m - 1.0$ and $\lg \rho_o = 0.22\Delta m - 0.5$. These completeness factors, due to Heintz (1969), are probably slightly optimistic in our case since they are used by Heintz only for $V < 9.0$ and $\delta > -30^\circ$. Thus, the number of new nss (1758) might be underestimated.

2. Precision of double stars measures

Figs. 1 - 2 show the mean errors $\sigma_d$ and $\sigma_{\Delta m}$ of the projected separation $d$ and magnitude difference $\Delta m$, as functions of $d$ and $\Delta m$. The m.e. are computed for a $4^s$ observation of a $B = 9^m$ star with the baseline instrument described in the note 7802-01. From the accumulated observations of a given system it should certainly be possible to improve $\sigma_{\Delta m}$ considerably. It has not been studied how (and if) the true separation $\rho$ and position angle $\theta$ can be derived from measured projected distances; thus $\sigma_d$ only gives a rough indication of $\sigma_\rho$. 