THEORETICAL COMPUTATIONS ON THE EFFICIENCY OF THE OVERLAP METHOD IN THE LICK PROGRAM

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1: DIFFERENCES BETWEEN THE PHOTOGRAPHIC SYSTEM AND AN ABSOLUTE SYSTEM

The theoretical computations suggested in section 5 of the preceeding paper have now been done.

It is necessary to do many approximations in order that the successive values of $\sum\beta^2$ give the limit. We have done as many as 8. After that the computation becomes too difficult.

In Table I, the values of $\sum\beta^2$, and the contribution $\sum\beta^2 \times E^2$ for each kind of measures at the systematic error E'^2 are given. Moreover the systematic error $\overline{\varepsilon}(\mu)$ in the proper motions following the values of E', and the same systematic errors without overlap method are given.

We have done also the computation in the case where all stars in the A.G. are measured, and the results are also in Table I.

2: SOLUTIONS FOR PLATES WITHOUT NEBULAE

We shall not study the whole problem, i.e. the precision with the overlap method in the centre of a zone 20° broad without nebulae. The computation would be too hard.

We study only the solutions for a line of plates overlapping, without nebulae for the plates in the centre of the line. The solutions will be, theoretically, calculated directly by inversion of the matrices.

For the computations, we admit one object (nebulae, stars of 12th magnitude, bright stars) per square degree. We calculate how the constants of the plates, next the proper motions, depend on the random errors of the measures. Then, we can estimate the systematic errors expected in the proper motions. On account of the scheme in line, we calculate only the systematic errors along the axis of line and for one coordinate.

We try a solution for a line of 12 plates overlapping as in the Lick program, 1° at the border of 6°, we eliminate the nebulae on 20° in the centre of a zone 61° long. The computation is impossible, even in double precision; the determinant is too small. It is obvious as the overlaps are too small.

In Table II, analogous to Table I, the values of $\sum\beta^2$ and the values of the contributions, $\sum\beta^2 E^2$, to the systematic errors E'^2 expected in the proper motions are given in different cases

I) For comparison:
Solutions of plates with nebulae, without use of overlapping.

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TABLE I

Systematic errors in the relation to absolute system in $(0''.01)^2$

Contributions of measures on	Lick Measures: Formulas I $\sum\beta^2$	Lick Measures: Formulas I $\sum\beta^2 E^2$	Lick Measures: Formulas II $\sum\beta^2$	Lick Measures: Formulas II $\sum\beta^2 E^2$	Measures on all the A. G. stars: Formulas I $\sum\beta^2$	Measures on all the A. G. stars: Formulas I $\sum\beta^2 E^2$	Measures on all the A. G. stars: Formulas II $\sum\beta^2$	Measures on all the A. G. stars: Formulas II $\sum\beta^2 E^2$
Nebulae	0.0105	8.4	0.0100	8.0	0.087	7.0	0.080	6.4
Stars 12th (I)	0.027	2.7	0.0170	1.7	0.026	2.6	0.013	1.3
Stars 12th (II)	0.0035	0.7	0.0200	4.0	0.007	1.4	0.006	1.2
Bright stars	0.0043	0.4	0.0260	2.6	0.0026	0.3	0.017	1.7
E'^2		12.2		16.3		11.3		10.6
$\overline{\mathcal{E}}(\mu)$ (20 years)		0''.175		0''.20		0''.168		0''.162
without overlapping		0''.264		0''.31		0''.264		0''.312

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II) Solution for a long line of plates, overlapping of 1° on 6°, at the border, with nebulae everywhere.

III) Solution for a long line of plates, overlapping of 3° on 6°, with nebulae everywhere.

IV) Solution at the centre of a line of 12 plates, overlapping of 3° on 6°, without nebulae in 18° in the centre.

V) Solution at the centre of a line of 12 plates, overlapping of 4° on 6°, without nebulae in 18° in the centre.

It is seen as, with the overlapping 2/3 (V) the quality of the results approach the quality in the cases of solutions with nebulae without the overlap method. It seems possible to obtain valuable solutions in the zone without nebulae under these conditions. For taking and measuring the plates the work will be only twice the work in other zones.

It will be necessary to adopt broader overlapping in the way perpendicular to the galactic plate, as in the other way.

The computations will be followed to discern the most economical method, studing the effects of different overlapping and of the number of measured objects.

Of course, if it is possible to obtain valuable estimates of constants of the plates by physical factors (preceeding paper No 9) one saving of work or one improvement of the solutions will be possible.

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TABLE II

Systematic errors in the secular proper motions in 0".01 (36 objects per plate)

	Contribution of measures on	Formulas I $\Sigma\beta^2$	Formulas I $\Sigma\beta^2E^2$	Formulas II $\Sigma\beta^2$	Formulas II $\Sigma\beta^2E^2$
I	nebulae	0.083	67	0.083	67
	Stars 12th (I)	—	-	0.083	8.3
	Stars 12th (II)	—	-	0.083	16.6
	E'^2		67		91.9
II	Nebulae	0.027	21.6	0.0245	19.6
	Stars 12th (I)	0.011	1.1	0.027	2.7
	Stars 12th (II)	0.0008	0.16	0.029	5.8
	Bright stars	0.0006	0.06	0.009	0.9
	E'^2		22.92		29.0
III	Nebulae	0.0125	10.0	0.0110	8.8
	Stars 12th (I)	0.018	1.8	0.020	2.0
	Stars 12th (II)	0.002	0.4	0.019	3.8
	Bright stars	0.005	0.5	0.023	2.3
	E'^2		12.7		16.9
IV	Nebulae	0.06	48	0.06	48
	Stars 12th (I)	0.79	79	0.74	74
	Stars 12th (II)	0.19	38	0.19	38
	Bright stars	0.69	69	0.72	72
	E'^2		234		232
V	Nebulae	0.020	16	0.020	16
	Stars 12th (I)	0.42	42	0.40	40
	Stars 12th (II)	0.10	20	0.10	20
	Bright stars	0.39	39	0.40	40
	E'^2		117		116

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