Definition of field angles

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The field reference frame s used by MATRA (P/L System Spec, issue 3) are uniquely defined by the projections onto the sky of the grid centre Og, midway on the great circle through the two marks M1 and M2 on either side of the primary grid. For the real data reductions, this definition is somewhat problematic in that the marks M1 and M2 are inaccessible to observation. The following is an attempt to clarify the concept of field angles \((\eta, \zeta)\) as used by NDAC.

The quantity which is fairly immediately available from the observations is the "transit time" of a given star at a given slit. In the primary field of view, this leads by inverse interpolation to the definition of a continuous "grid coordinate" \(G(t)\), such that \(G = (\text{slit number})\) along the centre of a slit. \((G = 0\) may correspond to the slit nearest to Og.) In the star mapper field, we take for simplicity the unweighted mean of the four transit times at the parallel slits in a "group", corresponding to the transit time at an imaginary "centre line" of the group.

It is clear that the origin of \((\eta, \zeta)\) in practice must be set by suitable constraints on the adopted relation between \((\eta, \zeta)\) on one hand, and \(G\) or the group centre lines on the other. If we neglect for the moment small-scale distortion, colour effects, and dependence on spatial frequency, we may write the relation in the primary field as

\[
G = g_{00} \pm h_{00} + (g_{10} \pm h_{10})\eta + (g_{01} \pm h_{01})\zeta + (g_{20} \pm h_{20})\eta^2 + \ldots
\]

(with upper/lower sign referring to the preceding/following field). For the star mapper, the centre lines may be represented by piecewise polynomials, e.g. for the chevron group

\[
\eta = \eta_c(\zeta) = \begin{cases} 
    a_0 + a_1\zeta + a_2\zeta^2 + \ldots & \text{above apex } (\zeta > \zeta_a) \\
    b_0 + b_1\zeta + b_2\zeta^2 + \ldots & \text{below apex } (\zeta < \zeta_b) 
\end{cases}
\]

With these representations, the origin of \((\eta, \zeta)\) is uniquely defined by the two constraints
(i) \( g_{00} = 0 \)

(ii) \( a_0 = b_0 \)

The second constraint means that the great circle \( \zeta = 0 \) goes through the two projections of the chevron apex (or, more precisely, the intersection of the extrapolated centre lines above and below apex); the first constraint puts the origin of the longitudinal field angle \( (\eta = 0) \) at the central slit, or more precisely at \( G = h_{00} \) in the p-field and \( G = -h_{00} \) in the f-field. (The difference in grid coordinate for the field centre \( \eta = \zeta = 0 \) between the two fields, \( G = \pm h_{00} \), arises from the NDAC convention to regard the basic angle \( \gamma \) as a fixed and exactly known number; \( -2h_{00}/g_{10} \) can be viewed as a "correction" to this nominal angle.)

**FIGURE.** Definition of field angles \((\eta, \zeta)\) according to NDAC. Origin is the intersection of the great circle through the two projections of the SM chevron apex with the lines \( G = \pm h_{00} \). Their separation on the sky is the a priori fixed basic angle \( \gamma \). (View from outside the celestial sphere.)