Chapter III

DESCRIPTION OF COMPUTER PROGRAMS DEVELOPED FOR THE APPLICATION OF THE METHODOLOGY

Introduction

During the course of this research two computer programs were developed to compute the evaluation measures and evaluation ratios described in the previous chapter by analyzing the driver eye movements and the driving performance data collected in this research. The two computer programs are called SEADEM I and SEADEM II (Sign Evaluation by the Analysis of Driver Eye Movements).

The program, SEADEM I, was developed as a part of the first one and one-half years of research efforts and it was designed to analyze data collected in Studies F-1 and F-4. This program did not consider exact highway geometry but rather assumed the highway to be perfectly plane and straight. This assumption was not too unrealistic as the majority of the data collected in the Studies F-1 and F-4 were collected on relatively straight and plane sections of interstate highways.

The computer program, SEADEM II, was further developed to satisfy the need for increasing accuracy and to consider exact locations of approaching signs with respect to driver's eye position as the driver travels on a highway with complex geometrics involving both the vertical and the horizontal curves. The SEADEM II was used to analyze data collected in Studies F-6, F-7, and F-8.

Basic Computational Task of SEADEM Programs

Both SEADEM I and SEADEM II perform the same basic task. The basic task essentially consists of separating the fixations that a driver makes as he approaches a sign (or signs, in case of multiple signs) into two categories; i.e., i) the fixations that present resolvable information of the message displayed on the sign, and ii) the fixations that do not present resolvable information from any portion of the displayed message.

In order to perform the task, the computer program analyzes each successive fixation that a driver makes as he approaches a sign. Let us assume that t is the time at which a driver makes a fixation; i.e., the fixation begins at time t. Then for that t, the computer determines the values of the following measures from the input data.

i. $[\sigma(t), \psi(t)]$ = angular location of the fixation (See Figure 3.1.)

ii. $x(t)$ = longitudinal distance of the driver from the sign

iii. $[\theta_1(t), \phi_1(t)]$ = location of the center of the sign

iv. $\eta_i(t)$ = eccentricity angle of the sign at i^{th} position on the sign

Note: $i = 1$ for center of sign, and $i = 2$ and 3 respectively denote positions at the left and right edge of the sign (See Figure 3.1.)

v. $\alpha[\eta_i(t)]$ = resolution angle measured in minutes of arc in the driver's visual field at eccentricity angle $\eta_i(t)$

vi. $\gamma_i(t)$ = angle subtended by largest letter size at i^{th} position

The program, then computes the values of the following ratio for each value of

$$\frac{\gamma_i(t)}{5.5\ \alpha[\eta_i(t)]} \qquad \text{for} \qquad i = 1, 2, 3$$

If any of the above three values are greater than or equal to 1.00, the fixation i considered to provide resolvable information of the sign to the driver.

The program, thus, determines all the fixations which provide resolvab information to the driver and computes T_{used}, T_f and T_e.

In order to determine T_{max}, the program performs the following comp tation:

T_{max} = value of t at maximum value of x(t) for which

$$\frac{\gamma_i(t)}{5.5\ \alpha[0^\circ]} = 1.0$$

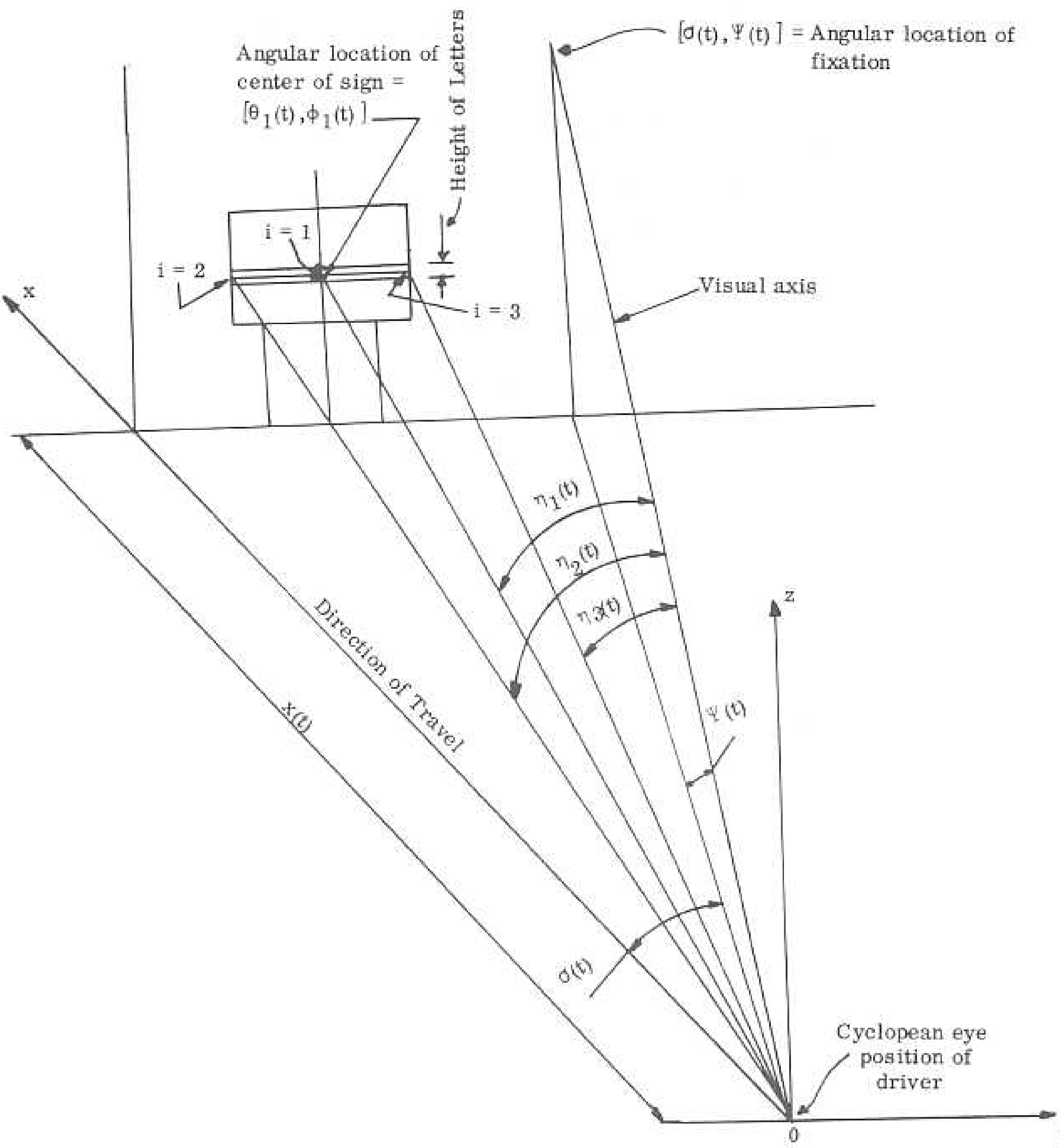

Figure 3.1.--Geometric Relationship of the Sign with Respect to the Driver's Cyclopean Eye Position

Thus, after obtaining T_{used}, T_f, T_e and T_{max}, the following evaluation ratios are computed:

$$T_{max}/T_{used},\ T_{max}/T_i,\ T_i/T_{used},\ \text{and}\ T_{max}/T_f.$$

Differences between SEADEM I and SEADEM II

The primary difference between SEADEM I and II are due to the differences in the input data required for each. Table 3.1 presents the basic differences in computation.

The computer program SEADEM I is described in detail in the interim report (Rockwell, et al., 1970) of this project and therefore, only the SEADEM II is presented in the succeeding pages of this chapter.

Table 3.1

Basic Differences in SEADEM I and II

Variable	Input data required to compute the variable	
	SEADEM I	SEADEM II
$x(t)$	determined by integrating velocity profile of the vehicle	determined by input from direct recording of distance by using the fifth wheel
$[\theta_i(t), \phi_i(t)]$	determined analytically by assuming straight highway by the knowledge of height and lateral position of the sign with respect to the driving lane	determined by input from recorded sign highway geometry master film

Specialized Instrumentation and Procedures Developed for Obtaining Sign-Highway Geometrics Data

As mentioned earlier, SEADEM II was developed to consider exact locations of approaching signs with respect to driver's eye position; i.e., cyclopean eye position, as he travels on a highway with complex geometrics.

In order to obtain data on the angular locations of the signs as a driver travels on the highway, a 16 mm camera with a 32^{o} wide angle lens was used. The camera was mounted at driver's eye height and at the center line of the car as shown in Figure 3.2. The instrumented vehicle was driven in a preselected lane on each of the test sections and the road was filmed at 2 frames per second film speed. At the same time, a fifth wheel was used to record distance. The distance was recorded on a Honeywell Oscillograph recorder in terms of blips after every 1/100 th of a mile traversed by the instrumented vehicle. In order to synchronize the fifth wheel and camera data, a synchronization device was used, which generated blips on the recording paper after every four and forty frames of the film. Figure 3.3 presents an example of the recorded paper data obtained from the Honeywell Oscillograph. In order to identify beginning and end of a run and also the instances when the vehicle passed the longitudinal plane of the sign, an additional stimulus trace was used. The circuit of the stimulus trace was so designed that it also lighted a bulb in the view of the camera so that film and paper data could be synchronized.

The film data was then reduced frame by frame and the coordinates of the centers of the sign (or signs, in case of multiple signs) for every frame of the film were punched on the cards. The oscilllgraph paper data was also reduced, and the film frame numbers corresponding to every 1/100 th of a mile blip were punched. Further, in addition to the above two sets of data, the lane position of the instrumented vehicle; i.e., the number of lanes in which the instrumented vehicle was driven, was obtained with respect to film frame numbers.

Thus, the following three sets of data cards, all synchronized on the basis of the film frame numbers, constitute complete data to define sign-highway geometry; i.e., location of sign with respect to any point on the highway:

i. locations of signs with respect to film frame numbers,

ii. film frame numbers corresponding to every successive 1/100 th of a mile, and

iii. frame numbers corresponding to driving lane numbers.

Figure 3.2.--Instrumented Vehicle Used for Collecting Sign-Highway Geometry Data

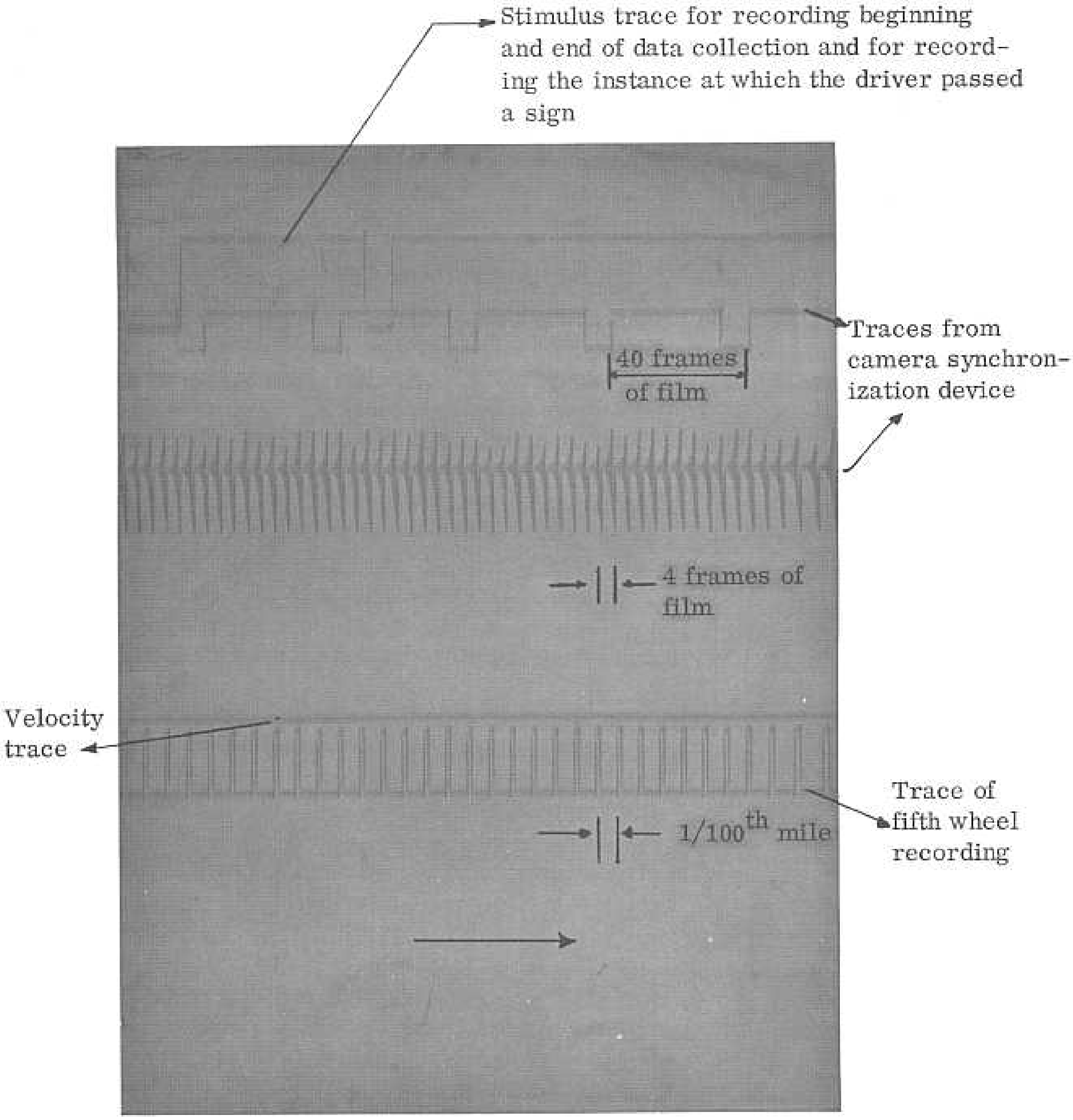

Figure 3.3.--An illustration of synchronized data obtained from Oscillograph

Procedures for Obtaining Synchronized Driver Eye Movements and Vehicle Performance Data

The experimental setup similar to that used for sign highway geometry data was used to collect data of subjects while driving. In the subject data collection runs, the 16 mm camera was mounted on a vertical piller (between roof and floor of the instrumented car) located between the front and the back seat. In this case, instead of the 32^{0} wide angle lens, the input of the scene lens and the eye spot were fed into the camera by means of a beam splitter (see Appendix B). The driver eye-movement data was collected at the film speed of 16 frames/second. The distance traversed by the driver was also recorded on paper by using the Honeywell Oscillograph and the fifth wheel. The synchronization device used for collecting the sign-highway geometry data was also used. Thus, the data of the test subjects consisted of the following:

i. 16 mm eye-movement film (recorded at 16 frames/second speed); from this data the following information was obtained:

   a. locations of successive eye fixations with respect to the perspective of the driving lane,

   b. durations of successive fixations,

   c. number of lane in which the driver was driving, and

   d. stimulus marks obtained fromthe bulb in the beam splitter: this information was used to identify beginning and ending of the trials and also the instances when the driver passed a sign.

ii. oscillograph paper data (recorded at 0.4 inches/second); from this data the following information was obtained:

   a. distance traversed in relation to the film frames, and

   b. stimulus marks that identify

      i. beginning and ending of runs, and

      ii. the instances when the driver passed a sign.

Inputs to SEADEM II

The inputs to the SEADEM II, therefore, consisted of two distinct types of data packages as follows:

Data Package Type I:	Sign-highway road geometry data: (referred in the program as S0; i. e., "Subject Zero" data.
Data Package Type II:	Subject data: driver-vehicle performance data collected during test runs.

The above two types of data packages were prepared for each test route and since a test route consisted of more than one sign locations and one or more signs at each location, the following scheme was used for assembling the data in each of the two types of packages.

Figure 3. 4 shows a sketch of one of the test routes used in Study F-6. This test route was numbered "231" and the data was collected at three sign locations, namely, 231-1, 231-2, and 231-3. Figure 3. 5 gives a computer print-out of the data package of Type I for the test route 231. The data package consists of many sub-packages (see Figure 3. 5) and the information contained in the sub-packages are briefly described in Table 3. 2.

Similarly, Figure 3. 6 presents an example of data package of Type II for Subject KF on test route 231. Table 3. 3 gives description of information that forms different sub-packages of the data package of Type II.

Description of the Computational Procedure of SEADEM II

The SEADEM II computer program is written in FORTRAN IV(G) and is set up to run in IBM 370/165. The program requires 91, 328 bytes of core. The setup time for this program on IBM 370/165 is approximately 30 seconds. The input data is stored by the program on disk units and 30 cylinders (2300 units) of data storage space is required for this purpose. The program consists of one main program and eight subroutine programs. The total number of FORTRAN statements in this program is over 675. The data processing time required by the program for a test route requiring approximately 180 seconds (real time) of driving time can be presented as follows:

i. approximately 10 seconds to process "S0" data for a trial; i. e., test route, and

ii. approximately 12 seconds to process data of each subject on the test route.

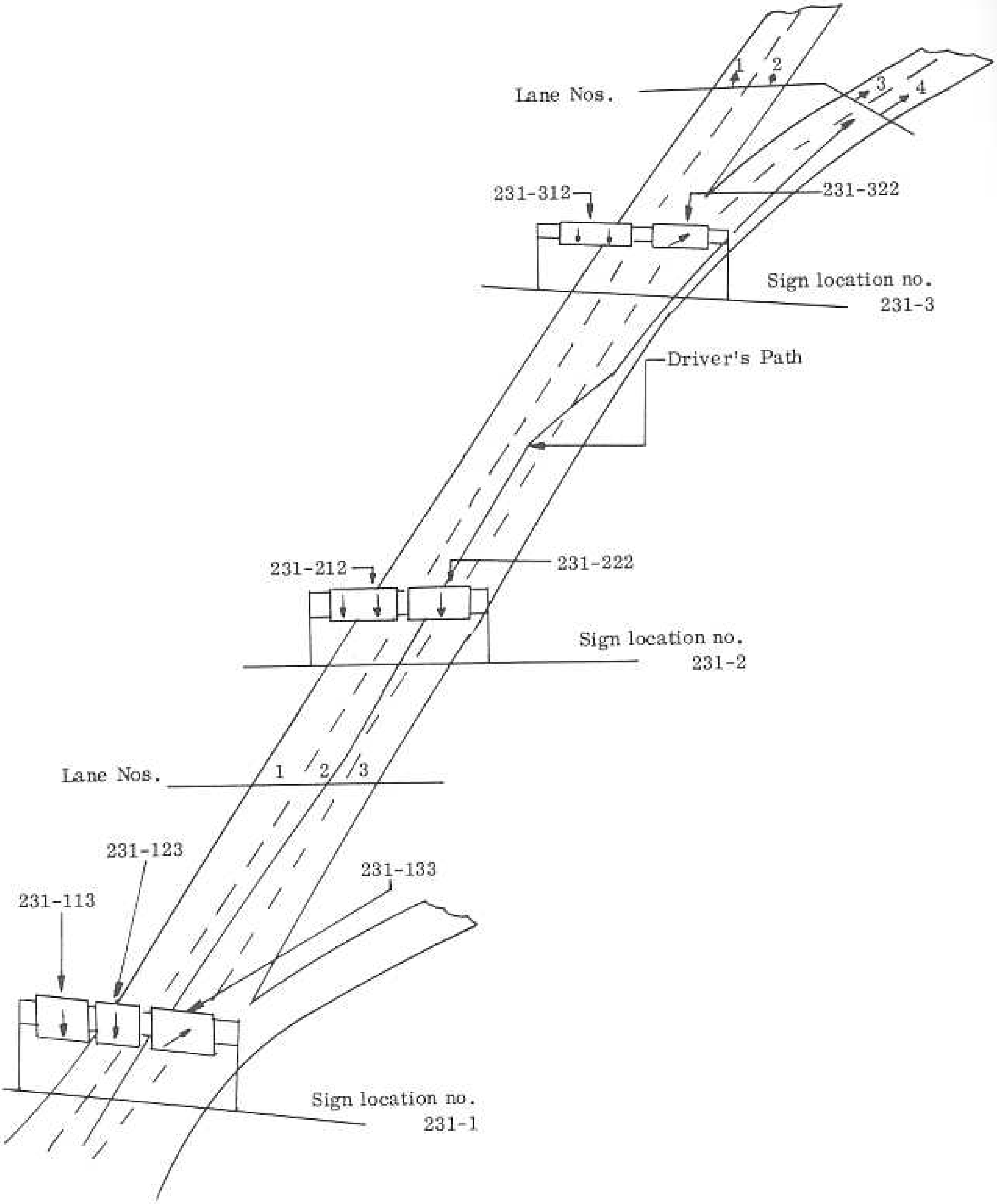

Figure 3.4.--Illustration of Identification Number System Used for Test Route Numbered 231

Table 3.2

Details of Data Package of Type I

Sub-package	Description of data in the Sub-package
A	For each sign at each location: a. message displayed by the sign b. type of informational need of the driver (NR = 00, NP = 10, PR = 11) c. no. of lines of message d. no. of words in the message e. no. of letters in the message f. height and width of the sign g. letter sizes
B	For each sign location: a. lane position information: lane numbers and film frame numbers at lane change b. film frame numbers at every 1/100th of mile distance (measured in the direction opposite to travel from the location of the sign)
C	For each sign location: a. film frame numbers measured from sign location (while reversing the film) b. coordinates of sign (or signs, up to three signs at the longitudinal sign location) corresponding to above film frame numbers Note: Coordinates of centers of signs were measured with reference to a fixed object in the car.

```
231   SU
231       70 WEST SPRINGFIELD I-270 WEST HEADING SOUTH
231 113 270 GROVE CITY
231 113  10    2     3    12       14.0          7.0          161210
231 123 70 WEST SPRINGFIELD
231 123  11    2     3    17       19.0         15.0          161210
231 133 ROBERTS ROAD                                                          A
231 133  10    1     2     9       16.0          8.0          161210
231 212 270 GROVE CITY
231 212  10    2     3    12       16.0          9.0          161210
231 222 70 WEST SPRINGFIELD
231 222  11    2     3    17       13.0         11.0          161210
231 312 270 GROVE CITY
231 312  10    2     3    12       11.0          7.0          161210
231 322 70 WEST SPRINGFIELD
231 322  11    2     3    17       10.0          7.0          161210

231-1 SU
    2     3     4     5     6     8     9    10    11    12    13    14    15    16
   17    18    19    20    22    23    24    25    26    27    28    29    30    31      B
   32    34    35    36    38    39    41    42    43    44
66666
231-2 SU          2
    1     2     3     4     5     6     7     8     9    11    12    13    14    15
   16    17    18    20    21    22    23    24    25    26    27    29    30    31
   32    33    34    35    36    38    39    40    41    42    43    44    46    47      B
   48    49    50    51    52    54    55    56    57    58    59    60    61    63
   64    65    66    67    68    69    71    72    73    74    75    76    77    79
   80    81    82    83    84    85    87    88    89    90    91    92    93    95
66666
231-3 SU       9003 8702
    1     2     3     4     6     7     8     9    10    11    12    14    15    16
   17    18    19    20    21    22    23    25    26    27    28    29    31    32      B
   33    34    35    36    37    39    40    41    42    43    44    45    47    48
   49    50    51    52    53    54
77777
231   SU                           b = (φ, θ), measured in arbitrary units
231-1SU
  997 7622 7634            996 7423 7432 7445    995 7223 7231 7241           40
  994 7123 7129 7137       993 6923 6929 6936    992 6923 6928 6934           41
  991 6823 6827 6833       990 6823 6827 6832    989 6723 6726 6731           42
  985 6623 6626 6629       981 6524 6526 6528    979 7537                     43     C
  978 7234                 977 7032              976 7031                     44
  975 6930                 974 6830              973 6829                     45
  972 6729                 971 6728              959 6627                     46
  965 6526                 958 6426                                           47
88888
231-2SU
  997 7620 7632            996 7421 7430         995 7221 7229                36
  994 7122 7128            993 7022 7028         992 6923 6927                37     C
  991 6823 6827            989 6723 6726         984 6624 6626                38
  976 6524 6525            955 6424 6425                                      39
88888
231-3SU
  997      7517            996 7301 7319 7326    995 7104 7120                31
  994 7008 7021            993 6910 6921 6926    992 6912 6922                32
  991 6614 6623            990 6716 6724 6727    989 6719 6726                33     C
  986 6621 6627            984 6621 6626 6628    983 6518 6522                34
  980 6519 6523            979 6520 6524 6525    978 6524 6527                35
99999
```

Note: Please refer to Table 3.2 for notation.

Figure 3.5.--An example of the data package of Type I

Table 3.3

Details of Data Package of Type II (Subject Data)

Sub-package	Description of data in the Sub-package
D	a. route number, e.g., 231 b. subject name, e.g., KF c. binocular foveal visual acuity of the subject d. film speed (0.0625 sec/frame)
E	For each sign location: a. lane position information Note: If "blank" computer assumes lane 1. b. film frame numbers at every 1/100th of mile distance (measured in the direction opposite to travel from the location of sign)
F	For each sign location: Details of successive eye fixations that a driver makes until he passes a sign location. This data includes: a. coordinates of fixations b. film frame number at which the fixations end c. details in the view where a fixation occurs, e.g., LC = lead car, OV = out of camera field.

```
231 KF
KF 20/30,
.0625
231-1 KF
     2    10    12    16    18    22    25    30    34    39    43    47    51    55
    57    59    65    69    73    77    80    84    88    92    95   100   102   106
   112   114   118   120   124   126   130   132   136   138   147   151   155   158
   162   165   169   171   175   178   182   189   192   196   200   204   208   212
   216   220   224   228   232   236   240   242   246   248   252   254   258   262
   266   268   272   276   280   284   288   292   299   302   306   309   313   315
   319   323   327   330   334   338   342   346   350   354   358   362   364   368
   370   374   377   381   385   389   394   402   404   409   413   417   424   426
   430   434   438   442   446   450   452   456   462   469   472   476   480   484
   488   492   496   498   502   504   508   512   516   520   524   526   532   536
   538   542   544   548   550   554   556   562   566   570   574   576   580   582
   586   590   594   598   602
22222
231-2 KF
     2     6     8    14    17    21    25    28    32    36    40    42    46    48
    54    57    61    65    69    73    77    81    83    89    91    97   101   106
   110   114   118   122   126   128   135   137   142   144   149   153   157   161
   165   169   173   178   180   184   186   192   195   200   202   206   210   214
   218   222   226   229   233   235   239   242   247   251   255   260   268   271
   276   278   282   284   288   290   294   298   302   306   310   314   318   322
   328   330   334   336   340   343   348   352   356   360   364   368   371   375
   378   382   385   390   392   396   400   404   408   412   414
22222
231-3 KF
     4     8    10    12    16    20    24    29    30    35    42    47    54    57
    62    67    70    74    77    82    83    90    94    98   106   108   114   117
   121   125   130   134
33333
231  KF
231?1KF
/00ST0001 E10RS0013 E10LC0015 F10RS0020 E11LC0034 /000V0129               25 231-1
 40
231?2KF
/00ST0017 /000V0025 E10LC0063 /000V0104 E11LC0120 F138 C132 F10LC0176     26 231-2
D11LC0180 /000V0190 D11LC0248 /000V0265 E11LC0272 /000V0275 D11LC02?1     27 231-2
/000V0287 D11LC0291 /000V031? D10LC0322 /000V0325 D10LC0331 E11LC0343     28 231-2
D10LC0421 /000V0436 D10LC0495 /000V0511 D11LC0577 /000V0620 E11LC0642     29 231-2
D10LC0658 D11LC0689 D09C?0693 D10LC0709 D09C?0723 D10LC0726 D11LC0752     30 231-2
/000V0759 D11LC0774 /000V0784 D10LC0812 /000V0817 D10LC0820 /000V0825     31 231-2
D11LC0829 /000V0842 E10?S0846 D09LC0847 /000V0863 D09LC0877 /000V0887     32 231-2
D10LC0890 /000V0896 D08LC0910 E10RS0933 /000V0985 E11?S0991 /000V1000     33 231-2
F10RS1004 F10RS1007 /000V1029 F10RS1033 /000V1034 D10LC1039 /000V1045     34 231-2
D10LC1050 /000V1076 D11LC1069 /000V0117                                   35 231-2
 90
231?3KF
/00ST0018 /000V0040 E11LC0042 /000V0051 D10LC0060 /000V0067 F10LC0077     36 231-3
/000V0080 E10LC0096 /000V0102 D10LC0110 /000V0133 D11LC0143 D10LC0146     37 231-3
D11LC0190 /000V0200 D11LC0205 /000V0217 D11LC0255 /000V0304 E11LC0305     38 231-3
/000V0332 E11LC0334 /000V0377 E11RS0405 /000V0424 F12RS0436 F13RS0445     39 231-3
F12RS0457 /000V0462 F11RS0471 /000V0545 E09RS0549                         40 231-3
 90
```

Note: Please refer to Table 3.3
for notation.

Figure 3.6.--An example of the data package of Type II

Figure 3.7 presents a schematic flow diagram of computation procedure programmed in SEADEM II. The program is designed such that it can process data collected over many test routes and for many subjects on a test route. The length of input data to be processed, therefore, depends upon the maximum time limit specified, and the computer program will continuously process the sets of data decks; i.e., repetitions of Step 1 followed by Step 2 type data, in succession. As shown in Figure 3.7, the program begins computational procedure by reading in the first data deck of Type I and performs the computational Stage I. In the computation Stage I, the input data is processed and restored in synchronized version; i.e., sign locations and lane position synchronized as a function of distance. Then it reads the first data deck of Type II for the first subject on the first test route and processes it through the computational Stages II and III. The computational Stage II is essentially similar to computational Stage I and it basically synchronizes the subject data; i.e., eye movements and lane positions, as a function of distance from the oncoming sign.

The computation Stage III actually analyzes every single fixation that a driver makes for all the signs at each of the approaching longitudinal sign locations. Figure 3.8 briefly illustrates some of the important steps in the computation Stage III. It should be noted that the subroutine SEEN has a built in visual accuity plot of the visual field of a driver with normal vision. This SEEN subroutine is the most important in this program. It determines the location of the driver at each fixation from the sign and computes the angles subtended by different sizes of letters. The angles subtended by the letters are then compared with the resolution angles in the drivers visual field at the computed eccentricity angles of the fixation at the three different locations on the sign (see Figure 3.1) and the "resolvability" of displayed information on the sign in that fixation is determined.

Figure 3.9 presents the isograms of resolution angles in 32^o visual fields of the driver with normal vision that is modeled in the subroutine, SEEN. It should be noted that here an assumption is made, that the isograms of resolution angles in 32^o binocular visual fields of humans are circular. This appears to be justifiable as the differences in visual acuity at different radial positions in the central vision are small. The subroutine SEEN adjusts the above modeled resolution angles according to binocular foveal visual acuity of an individual test driver. For subjects with above normal or subnormal binocular foveal visual acuity, the subroutine modifies the isograms within 4^o visual field in a linear fashion. Thus, for the drivers with below normal binocular foveal visual acuity; e.g., 20/40, the program increases the resolution angles within 4^o visual field. It should be noted that here an assumption is made that the visual acuity in only 4^o visual field is affected in case of subjects with above normal or below normal binocular foveal visual acuity.

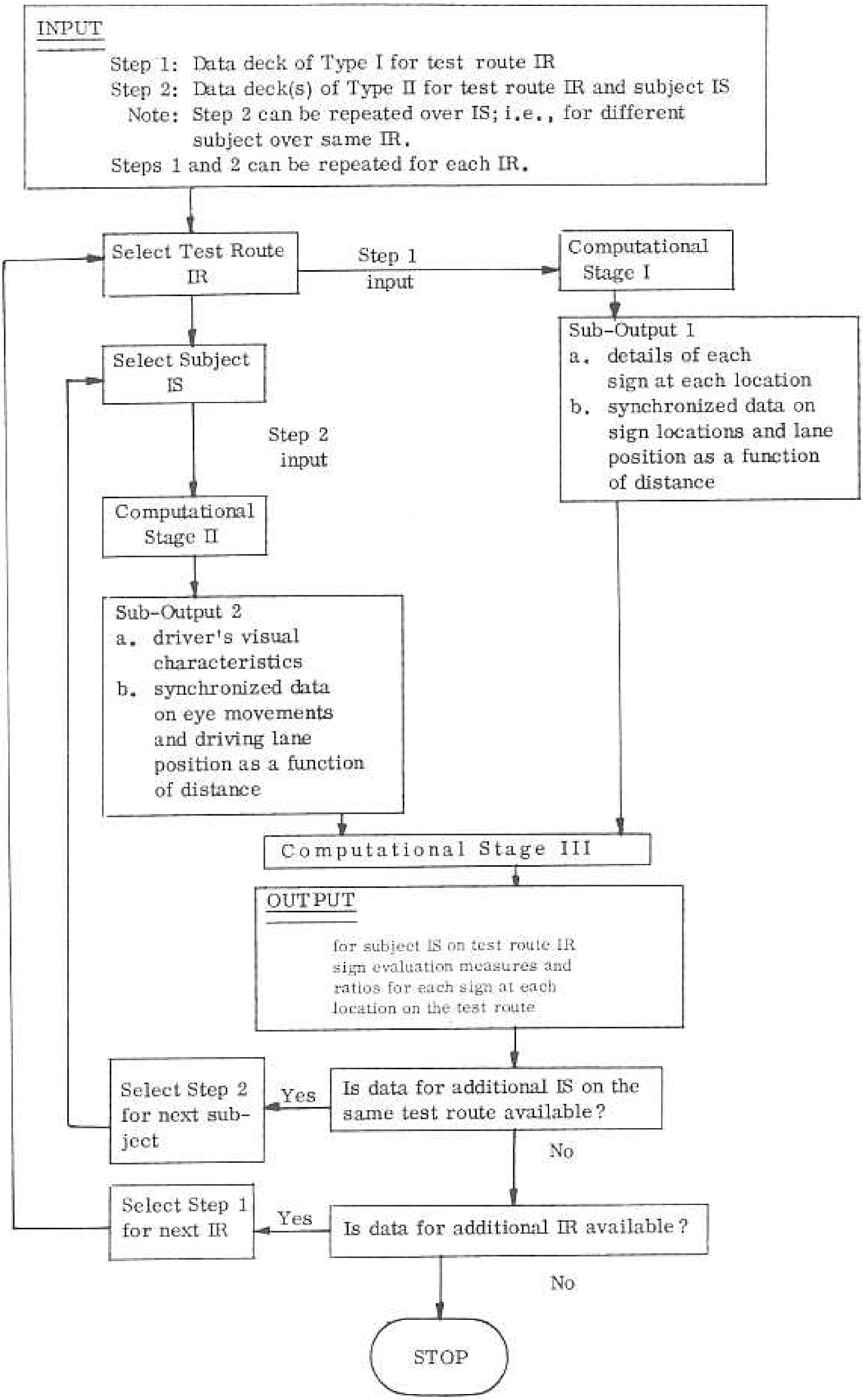

Figure 3.7.--Schematic Flow Diagram of the Computational Procedure of SEADEM II

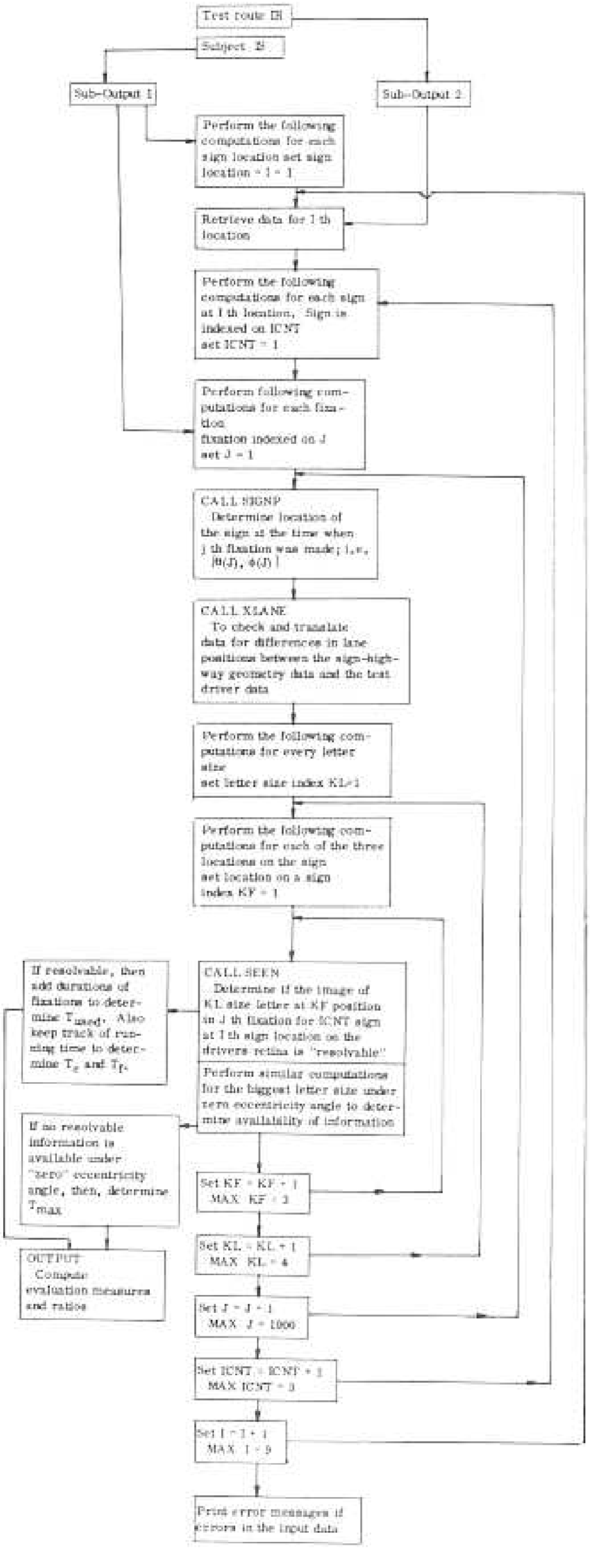

Figure 3.8.--Flow Diagram of Operations in Computational Stage III

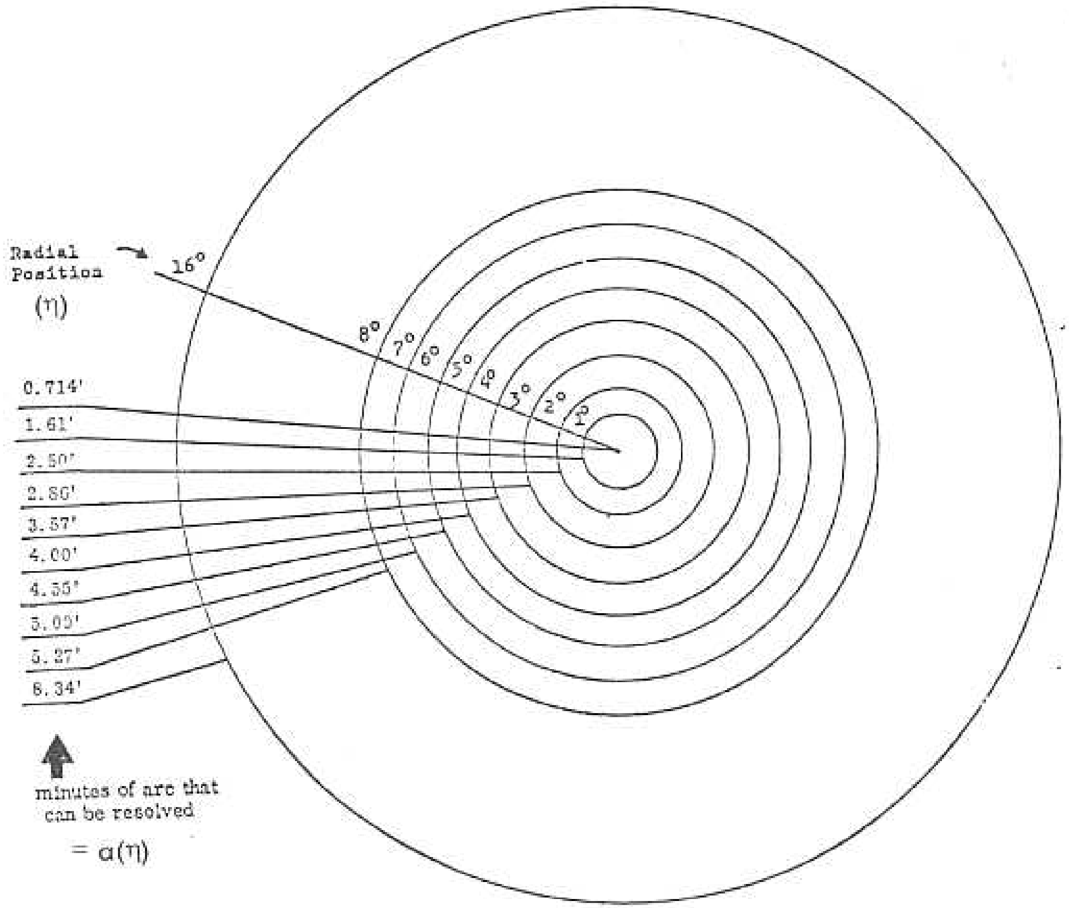

Figure 3.9.--Resolution angles in the 32° binocular visual field of drivers with normal vision

For more detailed discussions on this problem of modeling the visual acuity, an interested reader is referred to Rockwell, et al., (1970) and Bhise, (1971).

Since all the three computational stages of SEADEM II are complex and lengthy, a more detailed documentation of the program is considered to be beyond the scope of this report. An interested reader is, therefore, requested to refer to the project files on this research where detailed descriptions and listing of the program is presented. The project files can be obtained by contacting the Systems Research Group.

Illustration of Output of SEADEM II

In order to give the reader some idea on the output information obtained from this program, illustrative examples of partial computer printed outputs for the following three levels of computation are presented in Figures 3.10, 3.11, and 3.12 for a test route numbered 602:

i. sub-output 1 (Figure 3.10),

ii. sub-output 2 (Figure 3.11), and

iii. OUTPUT from computational Stage III (Figure 3.12).

RUN NUMBER=AK2

DESCRIPTION= AKRON RUN 1 JCT I-80S AND I-77

SIGN DETAILS

CODE	MESSAGE	SIGN SIZE(FT)	LETTER SIZES(IN			
602 112	JCT 77 1 MILE	13.00X 9.00	16.0	12.0	10.0	0.0
602 122	KENMORE BLVD	15.50X 6.00	16.0	12.0	10.0	0.0
602 212	77 NORTH CLEVELAND	13.00X 9.50	16.0	12.0	10.0	0.0
602 222	80S EAST AKRON ONLY	11.00X 9.50	16.0	12.0	10.0	0.0
602 312	77 NORTH CLEVELAND	13.00X 9.50	16.0	12.0	10.0	0.0
602 322	80S EAST AKRON ONLY	11.00X 9.50	16.0	12.0	10.0	0.0
602 412	77 NORTH CLEVELAND	13.00X 9.50	16.0	12.0	10.0	0.0
602 422	80S EAST AKRON	14.00X 7.00	16.0	12.0	10.0	0.0

SIGN LOCATION DETAILS

SIGN LOCATION 602-1

Note: Non-interpolated coordinates of centers of s
measured in arbitrary units (converted late
degrees).

DISTANCE	THETAS			PHIS			LANE
52.8	0	0	0	0	0	0	2
105.6	0	0	0	0	0	0	2
158.4	27	36	0	[illegible]	71	0	2
211.2	27	34	0	69	69	0	2
264.0	27	32	0	68	68	0	2
290.4	26	31	0	66	66	0	2
316.8	26	30	0	65	65	0	2
369.6	0	0	0	0	0	0	2
422.4	26	29	0	64	64	0	2
448.8	0	0	0	0	0	0	2
475.2	0	0	0	0	0	0	2
528.0	26	28	0	63	63	0	2
580.8	0	0	0	0	0	0	2
607.2	25	27	0	63	63	0	2
633.6	0	0	0	0	0	0	2
686.4	0	0	0	0	0	0	2
712.8	0	0	0	0	0	0	2
739.2	0	0	0	0	0	0	2
792.0	25	27	0	62	62	0	2
818.4	0	0	0	0	0	0	2
844.8	0	0	0	0	0	0	2
897.6	0	0	0	0	0	0	2
950.4	0	0	0	0	0	0	2
976.8	0	0	0	0	0	0	2
1003.2	0	0	0	0	0	0	2
1056.0	0	0	0	0	0	0	2
1082.4	0	0	0	0	0	0	2
1108.8	0	0	0	0	0	0	2
1161.6	0	0	0	0	0	0	2
1188.0	26	27	0	61	61	0	2
1214.4	0	0	0	0	0	0	2

SIGN LOCATION 602-2

DISTANCE	THETAS			PHIS			LANE
52.8	0	0	0	0	0	0	2
105.6	0	0	0	0	0	0	2
158.4	16	25	0	71	71	0	2
211.2	18	25	0	[illegible]	70	0	2
237.6	19	25	0	69	69	0	2
264.0	20	25	0	67	67	0	2
316.8	0	0	0	0	0	0	2
369.6	21	24	0	66	66	0	2

Figure 3.10.--An example of sub-output 1 obtained
from SEADEM II

SUBJECT FS BINOCULAR FOVEAL VISUAL ACUITY20 /20.

CAMERA SPEED 0.0625SECOND/FRAME

SIGN LOCATION = 602-1

FIX NO.	RUNTM (SEC)	DUR (SEC)	DISTANCE (FEET)	FIX LOC (THETAXFI)	DRIVER'S LANE	VEHICLE VEL(MPH)
1	0.06	0.06	5.9	(2, 2)	1	64.0
2	0.19	0.13	11.7	(1, 2)	1	64.0
3	0.44	0.25	23.5	(1, 1)	1	64.0
4	1.00	0.56	46.9	(2, 2)	1	56.9
5	1.13	0.13	93.9	(0, 1)	1	48.0
6	3.88	2.75	102.7	(2, 2)	1	53.1
7	5.69	1.81	316.8	(2, 1)	1	51.9
8	5.75	0.06	454.7	(2, 2)	1	48.0
9	5.81	0.06	459.1	(-10, -4)	1	48.0
10	6.13	0.31	463.5	(3, 2)	1	48.0
11	6.31	0.19	485.5	(3, 3)	1	48.0
12	6.38	0.06	498.7	(-10, -4)	1	57.6
13	6.56	0.19	503.9	(1, 1)	1	57.6
14	6.75	0.19	519.8	(2, 1)	1	57.6
15	7.00	0.25	535.6	(4, 1)	1	56.3
16	7.06	0.06	556.3	(-10, -4)	1	52.4
17	7.94	0.88	561.1	(2, 2)	1	50.8
18	8.56	0.63	626.3	(2, 1)	1	50.9
19	8.75	0.19	672.9	(2, 2)	1	57.6
20	9.13	0.38	688.7	(1, 1)	1	54.4
21	9.38	0.25	718.7	(2, 2)	1	48.0
22	9.75	0.38	736.3	(3, 2)	1	48.0
23	9.94	0.19	762.7	(50, -4)	1	48.0
24	10.00	0.06	775.9	(-10, -4)	1	48.0
25	10.25	0.25	780.3	(2, 1)	1	48.0
26	11.69	1.44	797.9	(2, 2)	1	56.3
27	11.69	0.0	916.7	(-10, -4)	1	56.3

SIGN LOCATION = 602-2

FIX NO.	RUNTM (SEC)	DUR (SEC)	DISTANCE (FEET)	FIX LOC (THETAXFI)	DRIVER'S LANE	VEHICLE VEL(MPH)
1	0.88	0.88	4.8	(1, 2)	1	52.4
2	1.06	0.19	72.0	(0, 2)	1	52.4
3	2.44	1.38	86.4	(1, 2)	1	76.7
4	2.94	0.50	229.0	(4, 2)	1	61.6
5	3.38	0.44	274.1	(3, 2)	1	64.0
6	3.63	0.25	315.2	(6, 0)	1	64.0
7	3.69	0.06	338.7	(-10, -4)	1	64.0
8	3.94	0.25	344.5	(3, 3)	1	52.0
9	4.13	0.19	363.6	(2, 2)	1	48.0
10	4.31	0.19	376.8	(3, 2)	1	48.0
11	4.44	0.13	390.0	(3, 1)	1	48.0
12	4.50	0.06	398.8	(-10, -4)	1	48.0
13	5.00	0.50	403.2	(6, 0)	1	48.0
14	5.38	0.38	438.4	(50, -4)	1	49.5
15	5.44	0.06	465.6	(-10, -4)	1	52.4
16	5.75	0.31	470.4	(7, 0)	1	52.4
17	5.88	0.13	494.4	(7, -1)	1	52.4
18	6.38	0.50	504.0	(7, 0)	1	56.9
19	6.44	0.06	545.8	(-10, -4)	1	57.6
20	7.06	0.63	551.0	(50, -4)	1	62.7
21	7.13	0.06	608.5	(-10, -4)	1	64.0
22	7.25	0.13	614.4	(7, 0)	1	72.0

Figure 3.11.--An example of sub-output 2 obtained from SEADEM II

ANALYSIS OF DRIVER EYE MOVEMENTS FOR EACH SIGN

SIGN NUMBER AF7 1 1

FIX NO	RUNTM	DUR	DISTANCE (FEET)	ECCENTRICITY (DEG.)	ANGLES SUB BY LETTERS 1	2	3	4	RESOLVABILITY 1	2	3	4				
1	0.06	0.063	5.87	0.0	768.	5.	4.	0.	NO	NO	NO	NO	0.043	0.404	2.000	2.000
2	0.19	0.125	11.73	0.0	389.	5.	4.	0.	NO	NO	NO	NO	0.043	0.404	1.000	2.000
3	0.44	0.250	23.47	0.0	195.	5.	4.	0.	NO	NO	NO	NO	0.043	0.404	1.000	1.000
4	1.00	0.563	46.93	0.0	98.	5.	4.	0.	NO	NO	NO	NO	0.043	0.404	2.000	2.000
5	1.13	0.125	93.87	11.19	48.	37.	30.	0.	YES	YES	YES	NO	0.043	0.404	0.0	1.000
6	3.88	2.750	102.67	8.45	44.	33.	28.	0.	YES	YES	YES	NO	0.043	0.404	2.000	2.000
7	5.63	1.813	316.80	1.67	14.	11.	9.	0.	YES	YES	YES	NO	0.029	0.342	2.000	1.000
8	5.75	0.063	454.67	2.03	10.	8.	6.	0.	NO	NO	NO	NO	0.029	0.326	2.000	2.000
9	5.81	0.063	450.17	12.94	10.	7.	6.	0.	NO	NO	NO	NO	0.029	0.325-10.000		-4.000
10	6.13	0.313	463.47	2.17	10.	7.	6.	0.	NO	NO	NO	NO	0.029	0.325	3.000	2.000
11	6.31	0.188	485.47	3.11	9.	7.	6.	0.	NO	NO	NO	NO	0.029	0.322	3.000	3.000
12	6.38	0.063	498.67	17.77	9.	7.	6.	0.	NO	NO	NO	NO	0.029	0.320-10.000		-4.000
13	6.56	0.188	503.95	1.49	9.	7.	6.	0.	NO	NO	NO	NO	0.029	0.320	1.000	1.000
14	6.75	0.188	519.79	1.00	9.	7.	6.	0.	NO	NO	NO	NO	0.029	0.318	2.000	1.000
15	7.00	0.250	535.63	2.26	9.	6.	5.	0.	NO	NO	NO	NO	0.027	0.317	4.000	1.000
16	7.06	0.063	556.27	12.58	8.	6.	5.	0.	NO	NO	NO	NO	0.023	0.317-10.000		-4.000
17	7.94	0.875	561.07	2.00	8.	6.	5.	0.	NO	NO	NO	NO	0.023	0.317	2.000	2.000
18	8.56	0.625	626.27	1.09	7.	5.	5.	0.	NO	NO	NO	NO	0.014	0.316	2.000	1.000
19	8.75	0.188	672.91	3.04	7.	5.	4.	0.	NO	NO	NO	NO	0.014	0.312	2.000	2.000
20	9.13	0.375	688.75	1.14	7.	5.	4.	0.	NO	NO	NO	NO	0.014	0.311	1.000	1.000
21	9.38	0.250	718.67	2.07	6.	5.	4.	0.	NO	NO	NO	NO	0.014	0.309	2.000	2.000
22	9.75	0.375	736.27	2.54	6.	5.	4.	0.	NO	NO	NO	NO	0.014	0.308	3.000	2.000
24	10.00	0.563	775.87	12.05	6.	4.	4.	0.	NO	NO	NO	NO	0.014	0.305-10.000		-4.000
25	10.25	0.250	780.27	1.19	6.	4.	4.	0.	NO	NO	NO	NO	0.014	0.305	2.000	1.000
26	11.69	1.438	797.87	2.11	6.	4.	4.	0.	NO	NO	NO	NO	0.014	0.304	2.000	2.000
27	11.69	0.0	816.67	11.85	5.	4.	3.	0.	NO	NO	NO	NO	0.019	0.300-10.000		-4.000

AVERAGE VELOCITY IN MPH = 53.48
DTMAX = 10.63
TSMAX = 11.69

TSMAX=	11.68750	(T_{max})
TTT=	4.68750	(T_{used})
BFLDC=	1.00000	(T_a)
BFLDC=	5.68750	(T_ϕ)
NNOO=	3	(Number of fixations)
TIPB=	4.6875	(T_I)
RATIO1	2.49333	(T_{max}/T_{used})
RATIO2=	2.49333	(T_{max}/T_I)
RATIO3=	1.00000	(T_I/T_{used})
RATIO4=	2.05494	(T_{max}/T_ϕ)

Figure 3.12.--An example of output from computational stage III of SEADEM II