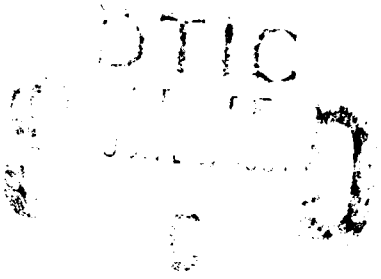
ESD-TR-91-057



Technical Report
920

Logical Implementation of the Automatic Target Recognition Working Group (ATRWG) 9-Track Tape Format Image Storage Format

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9 April 1991

Lincoln Laboratory
MASSACHUSETTS INSTITUTE OF TECHNOLOGY
LEXINGTON, MASSACHUSETTS

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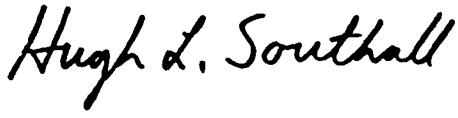
FOR THE COMMANDER



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MASSACHUSETTS INSTITUTE OF TECHNOLOGY
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LOGICAL IMPLEMENTATION OF THE AUTOMATIC TARGET RECOGNITION WORKING GROUP (ATRWG) 9-TRACK TAPE FORMAT IMAGE STORAGE FORMAT

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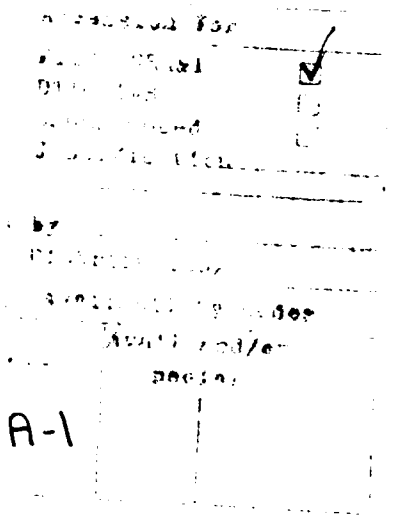
Group 53



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ABSTRACT

A standard image storage format has been developed for raw sensor imagery. This format retains all the sensor information from the header of the original data tape. The image data are stored in packed binary form.

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1. INTRODUCTION

Over the past two years, the Opto-Radar Systems Group has spearheaded the effort to select and incorporate a standard file format for raw sensor imagery. The goal of this effort is to use only one format for the multiple computing facilities and thus eliminate the problem of individual users creating custom software. Such a format must include all the header information that existed on the original data tapes, so all the available sensor information is retained. The format selected, called the NATO format within the Opto-Radar Systems Group, is a subset of the NATO data format developed by the Automatic Target Recognition Working Group (ATRWG). This format is apparently widely used in the ATR community. Thus, an additional benefit to such a format is the ability to transport data to and from other ATR facilities.

2. STORAGE CONVENTIONS

The ATRWG format, like all other image formats, is unique in its representation. Each image is an independent unit on the disk file or tape. An overview of the format is shown in Figure 1. Each image consists of a first header, a second header, and pixel data (video, range, passive, etc.). The record size is fixed at 512 bytes.

The first header is the first record and contains information specified by the ATRWG standard: the size of the image, number of bits per pixel, date of storage, etc. The first 128 bytes are the formal ATRWG header. The remaining 384 bytes (which can be blank) are used as an internal header for the Opto-Radar Systems Group. This internal header is usually obtained either directly or after some calculation from the original sensor tape header. It contains sensor-specific information: field of view, range gate, tape rack number, etc. Appendix A gives a detailed description of the first header.

The second header is optional. Its length and contents are user-defined. It is normally coded in ASCII and thus can be used for data description. The second header usually contains the original header from the sensor data tape. It may also contain information about processing steps that have been applied to the image. A detailed listing of the original sensor tape header is given in Appendix B.

Finally, the image data are stored as packed binary data (low byte first). They are contained in the minimum number of records required to store the image in raster form. A data package usually consists of the following eight images for each scene: video, range intensity, range, passive-IR intensity, range intensity with perspective, range with perspective, passive-IR intensity with perspective, and altitude with perspective. Each image is stored in a separate file using the following format: first header, second header, and pixel data.

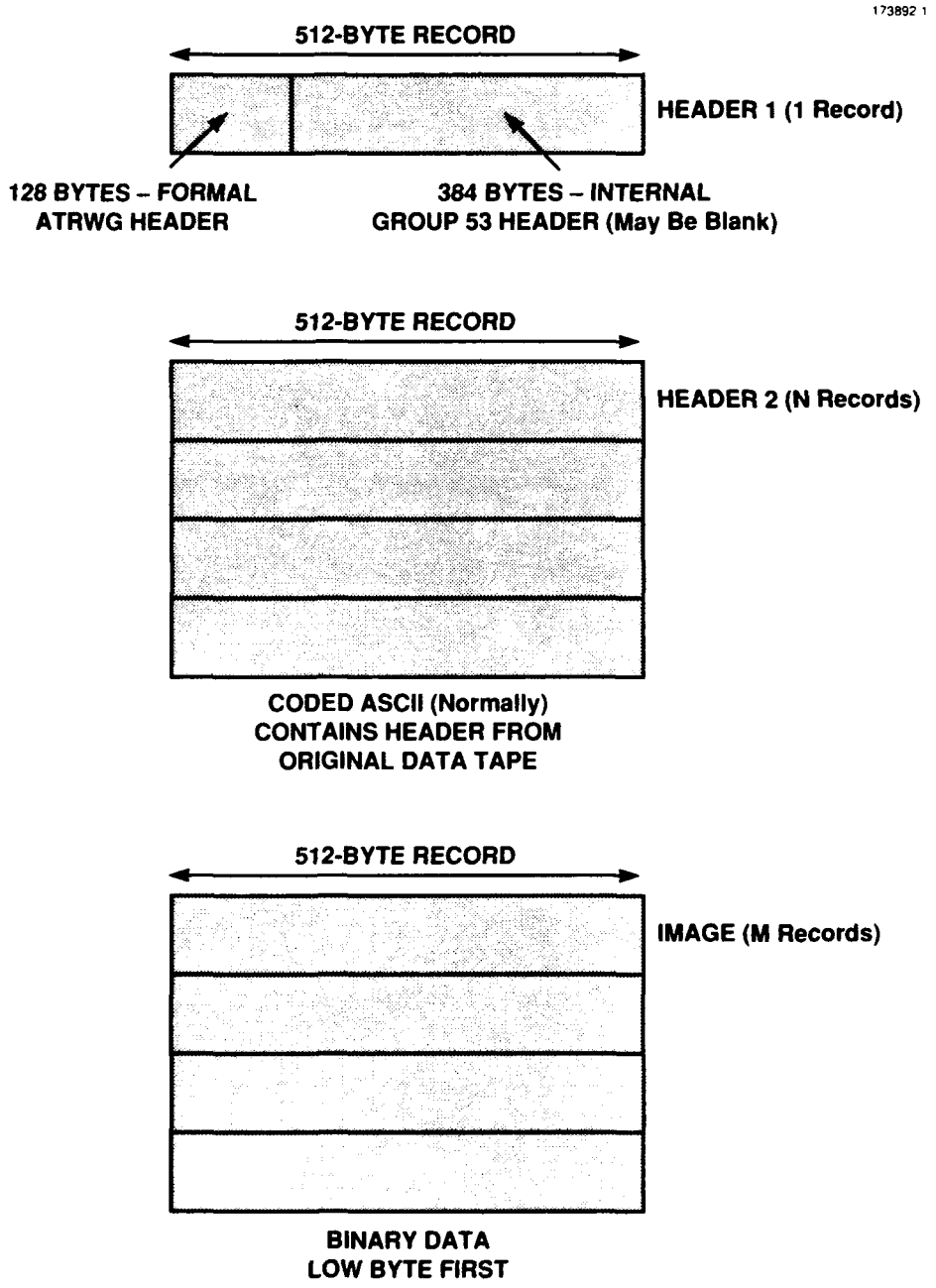

Figure 1. ATRWG File Format: Fixed record length of 512 bytes. Record 1 for Header 1, record 2 to N for Header 2, and record N+1 to (N+1)+M for pixel data.

APPENDIX A
NATO/ATRWG HEADER SUMMARY

The following summary is based on ATRWG Format Specification for 9-track computer tapes, Document Number ATRWG 83-001, which was adopted in September 1983.

A.1 Comments

The header as implemented on the VAX consists of 512 bytes for each image. The header gives information on the second header, if it exists. All images are written in binary code, which is the most compact representation. The record size is fixed at 512 bytes per record. Data are stored in two's complement, least significant byte first (VAX standards). For external distribution, data are stored at 6250 bpi with one image per file (ATRWG standard is 1600 bpi). For internal use, images can be stored all in one file. Currently, only byte and 16-bit images can be handled.

A.2 Decoding the First Header

The first 128 bytes conform to the NATO/ATRWG standard for each image and contain sufficient information to display the image. The remaining 384 bytes are used to provide additional information about the image but are not really needed. The first 128 bytes are ASCII encoded.

1–4	Country of origin ('USA')
5–8	Originator ('LL53')
9–16	Date data was recorded or generated (Format: yy mm dd)
17–24	Image identifier
	1 = video
	2 = range intensity
	3 = range
	4 = doppler intensity
	5 = doppler
	6 = passive
	7 = synthetic
	8 = 16-bit range intensity
	9 = 16-bit range
	etc.

25–32	Number of records for images plus headers
33–40	Number of 8-bit bytes in Header 2 [may be 0 (zero)]
41–48	Number of 8-bit bytes per record in this file (equals 512)
49–56	Number of entries per sample
	1 = monochrome data
	2 = complex data or two channels per sample
	4 = complex data with two channels per sample
57–64	Number of bytes per integer entry
	0 = for real data
	1 = byte data
	2 = I*2 data
65–72	Number of bytes per mantissa of a real entry
	0 = integer data
73–80	Number of bytes per exponent of a real entry
	0 = integer data
81–88	Number of samples per image line (number of columns)
89–96	Number of lines per image (number of rows)
97–104	Type of data values for imagery
	0 = noncomplex data with integer entries
	1 = complex data with integer entries
	2 = noncomplex data with integer entries
	3 = complex data with real entries
	4 = program units
	5 = unsigned integer data
105–112	Auxiliary data type field
	Only used if data are not in a form mentioned above.
	Overrides bytes 57–80 and 97–104
113–120	Format for Header 2
	0 (zero) or blank = free format ASCII text
121–128	Number of image lines per tape record

A.3 Internal Header Information - (Not ATRWG Standard)

129–192	64-character description of image data
193–224	Original tape number or file name
225–232	Original file or bundle number
233–240	Original record number
241–248	Original file or bundle number of next image
249–256	Original record number of next image
257–264	Image type
	1 = video
	2 = range intensity
	3 = range
	4 = doppler intensity
	5 = doppler
	6 = passive
	7 = synthetic
	8 = 16-bit range intensity
	9 = 16-bit range
	etc.
265–272	Number of rows
273–280	Number of columns
281–288	Number of bits per pixel
289–296	Image access
	0 = raster format
	1 = transpose format
297–304	Images per bundle
305–312	Image order and types
	(Example: 2 3 6 1 = range intensity, range, passive, video)
313–320	Number of images per record on original tape
321–328	Date when data taken
	(Format: day of year*100 + last two digits of year)

329–336	Number of bytes in second header
337–344	Range gate width in mm
345–352	Range gate start offset in mm
353–360	Horizontal field of view per pixel in μrad
361–368	Vertical field of view per pixel in μrad
369–376	Time of day (Format: decimal hh mm ss)
377–384	Range quantization in mm
385–448	Bytes 257–384 encoded here as 16i8 binary format
449–480	Original name of file that data is written to
481–492	User name of file originator
493–504	Date when image is written
505–512	Time when image is written

APPENDIX B
FLYABLE IRAR HEADER FORMAT

BYTE	DESCRIPTION
0:	
D7	0 → Flyable system
D6	0 → 64 × 128, 1 → 124 × 128
D5	0 → 1 byte/pixel, 1 → 2 bytes/pixel
D4	1 → Passive channel enable
D3	1 → Active (pulse) intensity data
D2	1 → Active (pulse) range data
D1	1 → Boresight TV data
D0	1 → Passive data
1:	
D7	0 → Pulse data available
D6	1 → Doppler available
D5	1 → Doppler intensity data
D4	1 → Doppler velocity data
D3	1 → 100 μrad 0 → 50 μrad
D2	1 → Frame mode oversampled
D1	0 → 10^o FOV, 1 → 20^o FOV
D0	0 → 5 Hz (linescan), 1 → 2.5 Hz (linescan)
2:	
D7	0 → Linescan, 1 → frame
D6	1 → V-lock (no vertical scan - frame mode)
D5	MSB
	Boresight interlace
D4	LSB
D3	MSB
D2	Frame position (linescan)
D1	Vertical offset (oversampled frame mode)
D0	LSB

All subsequent bytes are ASCII characters D7 = 0.

BYTE	DESCRIPTION
3	MSD
4	File number
5	
6	LSD
7	MSD
8	
9	Records in last file written by system
10	
11	LSD
12	MSD System mod number
13	LSD
14	MSD Bits/word, range data
15	LSD
16	MSD Bits/word, passive data
17	LSD
18	MSD
19	Range increment/bit (interpreted as "xx.x")
20	LSD
21	
22	Range increment units ("MET ")
23	
24	
25	MSD
26	Range gate start (× 100 ft)
27	LSD
28	MSD Range gate width (× 100 ft)
29	LSD

BYTE	DESCRIPTION
30	HRS × 10
31	HRS
32	MIN × 10 Time
33	MIN
34	SEC × 10
35	SEC
90	SEC × 0.1
36	DAYS × 100
37	DAYS × 10
38	DAYS Date
39	YR × 10
40	YR
41	SIGN
42	MSD Temperature (degrees C; not used)
43	LSD
44	MSD Relative humidity (percent; not used)
45	LSD
46	SIGN
47	MSD Azimuth pointer in image mode (flyable)
48	TV only during linescan (flyable)
49	interpreted as
50	LSD "± × × × ×" counts (flyable), where 1 count = $\frac{2\pi\, radian}{2^{16}}$.
51	SIGN
52	MSD Elevation pointer—all modes
53	interpreted as
54	"± × × × ×" counts (flyable)
55	LSD where 1 count = $\frac{2\pi radian}{2^{16}}$.

BYTE	DESCRIPTION
56	MSD
57	VCO Output
	(interpreted as "× × ×.×" MHz; not used)
58	
59	LSD
60	MSD
61	ΔF Output (same as VCO; not used)
62	
63	LSD
64	MSD
65	M.O. power output (interpreted as "× × ××" in
66	arbitrary units; not used)
67	LSD
68	MSD
69	Airspeed × × × (Kt)
70	LSD
71	MSD
72	
73	Barometer × × . × ×× (inches Hg)
74	
75	LSD
76	MSD
77	Heading × × ×^{o}
78	LSD
79	
80	SIGN
81	MSD
82	Pitch ± × ×. × ×^{o} (+ = nose up)
83	
84	LSD

BYTE	DESCRIPTION
85	SIGN
86	MSD
87	Roll ± × ×. × ×^{o} (+ = right wing down)
88	
89	LSD
91	MSD Zoom 0 to 99%
92	LSD
93	Marker ("M" indicates mark button pushed.)
94	
95	MSD
96	Reference pressure × × . × × (inches Hg)
97	
98	LSD
256-319	Target
320-383	Location
384-447	Weather
448-511	Miscellaneous

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