Army Research Laboratory

The Distributed Unattended Networked Sensors Field Experiment

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Sensors and Electron Devices Directorate

Abstract

Field experiments are crucial in developing and evaluating acoustic sensors for target detection, direction finding, classification, and identification. The U.S. Army Research Laboratory (ARL) regularly conducts field experiments to demonstrate and evaluate real-time performance of the acoustic sensor test bed and to collect signature data of new targets for an ARL acoustic and seismic database. During 20 to 30 September 1999, ARL conducted a field experiment on Spesutie Island, Aberdeen Proving Ground, Maryland, as part of the Distributed Unattended Networked Sensors (DUNES) program. The main objectives of this experiment were to demonstrate the advances of the new generation of acoustic sensors and to collect data of new targets. This report documents the field test log, sensor array descriptions, and meteorological data from that experiment.

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Executive Summary

Acoustic sensors provide low-cost, non-line-of-sight, long-range detection, tracking, classification, and identification of targets. On the battlefield, acoustic/seismic sensors are deployed unattended and target information is radioed to a combat information processor, where real-time target positions are displayed on a digitized map of the terrain. The use of battlefield acoustic sensors minimizes the number of personnel engaged, thereby reducing the potential loss of life.

The U.S. Army Research Laboratory (ARL) is an established leader in battlefield acoustics research and development. ARL's new generation of acoustic sensors is easy to operate, is controllable remotely, and can log data onto hard disks. ARL's state-of-the-art acoustic database has been requested by numerous researchers from other government agencies, industry, and academia. The newly developed automatic target recognition laboratory expedites algorithm evaluation by integrating the database and user-developed algorithms into one application.

To maintain its position as a leader in battlefield acoustics, ARL needs to continually improve its existing algorithms, sensor hardware, and signature database. Field tests are an important aspect of algorithm and sensor development since they provide real-time opportunities to evaluate and demonstrate new software/hardware capabilities. Field tests also provide opportunities to populate the acoustic database with valuable data. Because the Army is moving toward the development of Future Combat Systems (FCS), battlefield acoustics will play a role in FCS survivability and lethality. Because hardware/software requirements are always changing, field tests will always be an important aspect of ARL's research and development effort.

1. Introduction

The U.S. Army Research Laboratory (ARL) conducted the Distributed Unattended Networked Sensors (DUNES) field experiment on Spesutie Island at Aberdeen Proving Ground, Maryland, from 20 to 30 September 1999. The main objectives of the field test were to:

- Demonstrate the advances in acoustic technology for real-time detection, tracking, localization, and identification of ground and air targets,
- Demonstrate a communication link through the use of a new radio link,
- Evaluate the new-generation acoustic sensor test bed, and
- Collect signature data at each sensor array to integrate into the acoustic and seismic database.

This report records the field test log, sensor array positions, configurations, and meteorological data of this field experiment.

2. Test Overview

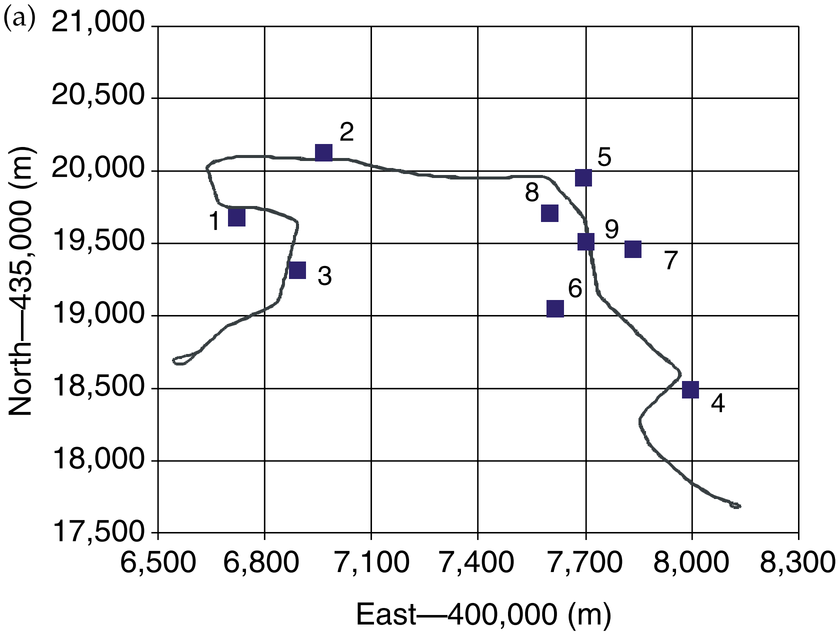
Eight acoustic and acoustic/seismic arrays were strategically placed along the path to be traveled by the target(s). Four of the targets were classified and are referred to as targets 1, 2, 3, and 4 in this report. The unclassified ground targets were an M1A1, an M60, a T62, a T72 (all heavy tracked vehicles), an MAZ537 (a light tracked vehicle), a ZIL (a light wheeled vehicle), a BMP2 (a tracked carrier), and a BTR80 (a light tracked vehicle). Test runs consisted of single and multiple targets at various speeds and separation distances. Each sensor array transmitted a line of bearing via the radio frequency (rf) link to a gateway. The gateway calculated two-dimensional coordinates of detected targets in real time and transmitted this signature data to the combat information processor (CIP), which displayed the target-tracking information in real time on a digitized map of the terrain. Target signatures at each sensor array were logged onto the sensor's hard drive.

3. Sensor Array Coordinates and Path Descriptions

Figure 1(a) and (b) shows the nine sensor arrays deployed during this field test. Arrays 1 to 8 were placed as shown. Array 9 was used in a stand-alone test where it was placed on an idle M113 to track a moving M60. Ground targets followed either path, as depicted in the figure, with the exception of a few runs where both paths were used. Path 1 is asphalt and path 2 is a gravel/dirt loop. Table 1 lists the coordinates of the arrays. Not all arrays were active at all times.

Figure 1. Sensor array positions and target paths in universal transverse mercator (UTM) coordinates: (a) asphalt and (b) gravel/dirt loop.

(a)



(b)

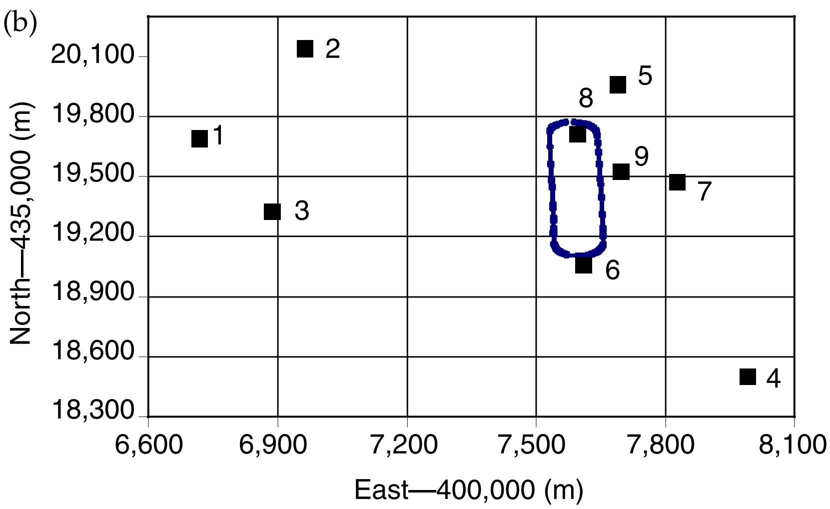


Table 1. Sensor array coordinates.

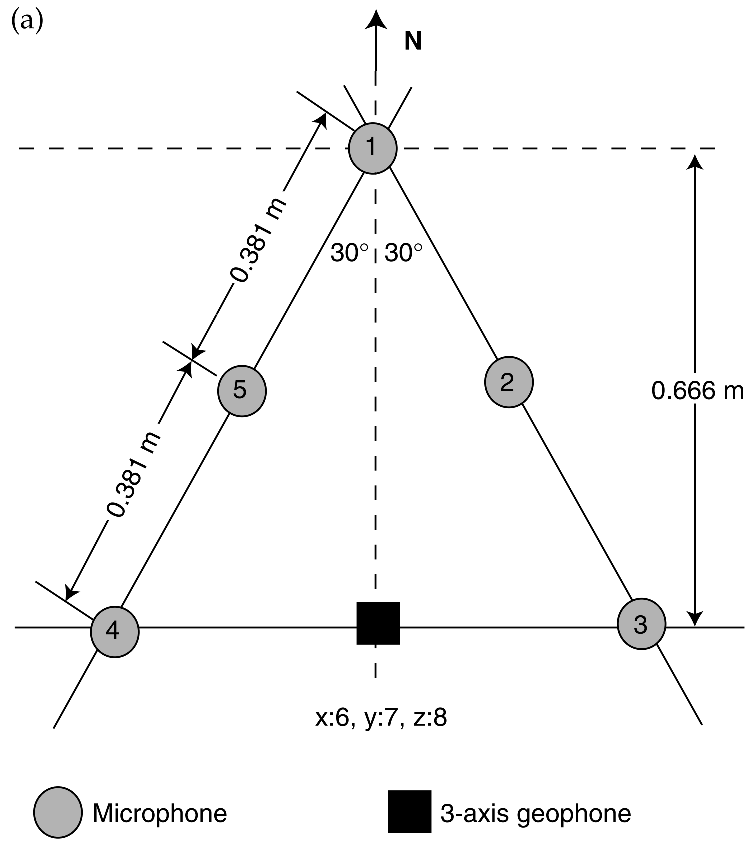
Array number	North (UTM)	East (UTM)
1	4369687	406719
2	4370139	406963
3	4369324	406887
4	4368500	407992
5	4369958	407689
6	4369058	407610
7	4369472	407828
8	4369712	407596
9	4369524	407697

4. Sensor Array Configurations

Table 2 lists the geometry and numbers of acoustic/seismic sensors for each array used in the field test. Figure 2(a) to (e) depicts the array configurations. Acoustic sensors used for these arrays were Knowles microphones. A three-axis geophone provided seismic signals from array 4 (fig. 2(a)); this was the only array having both acoustic and seismic sensors. Arrays 7, 8, and 9 were experimental arrays used for the first time. Array 7 consisted of two concentric seven-microphone circular arrays as depicted in figure 2(d). Array 8 consisted of three seven-microphone circular arrays in a line, separated by 25 ft, as depicted in figure 2(c). Array 9, shown in figure 2(e), was a five-microphone circular array mounted atop a stationary M113 with its engine on to track a moving M60 tank. Two electrostatic sensors were placed next to array 8 for an independent data collection.

Table 2. Sensor array configurations.

Geometry	No. of acoustic sensors	No. of seismic sensors	Array No.	Figure
Triangular	5	3	4	2(a)
Circular	7	0	1, 2, 3, 5, 6	2(b)
Circular	21	0	8	2(c)
Concentric	13	0	7	2(d)
Circular	5	0	9	2(e)



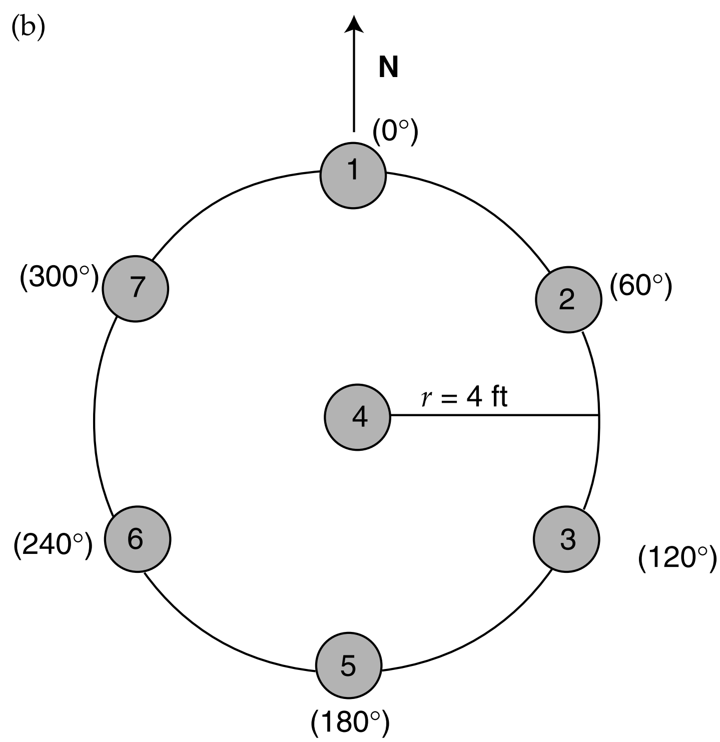
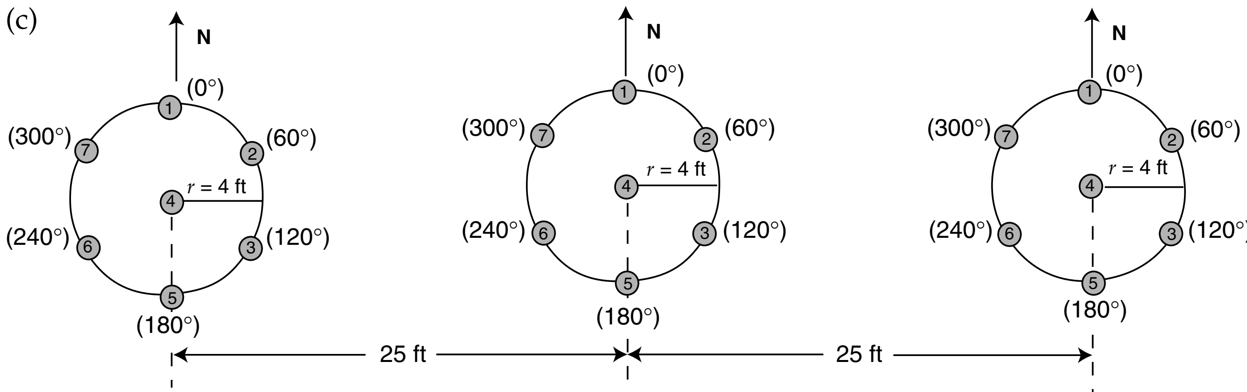


Figure 2. Sensor array configurations for (a) ARL's five-acoustic/three-seismic triangular array and (b) ARL's seven-acoustic circular array.

(c)



(d)

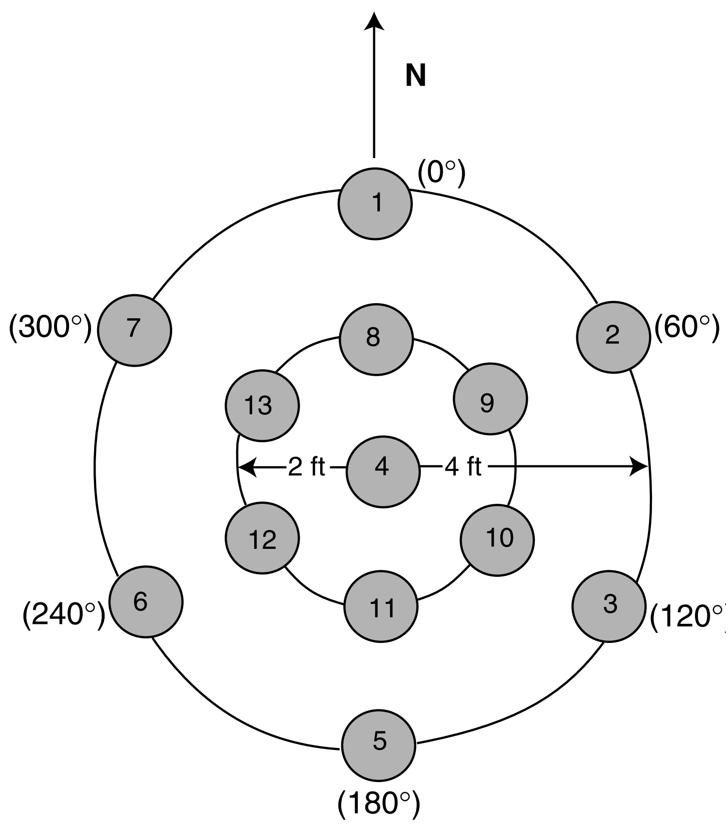


Figure 2 (cont'd). Sensor array configurations for (c) ARL's seven-acoustic circular arrays with 25-ft separation and (d) ARL's concentric circular arrays.

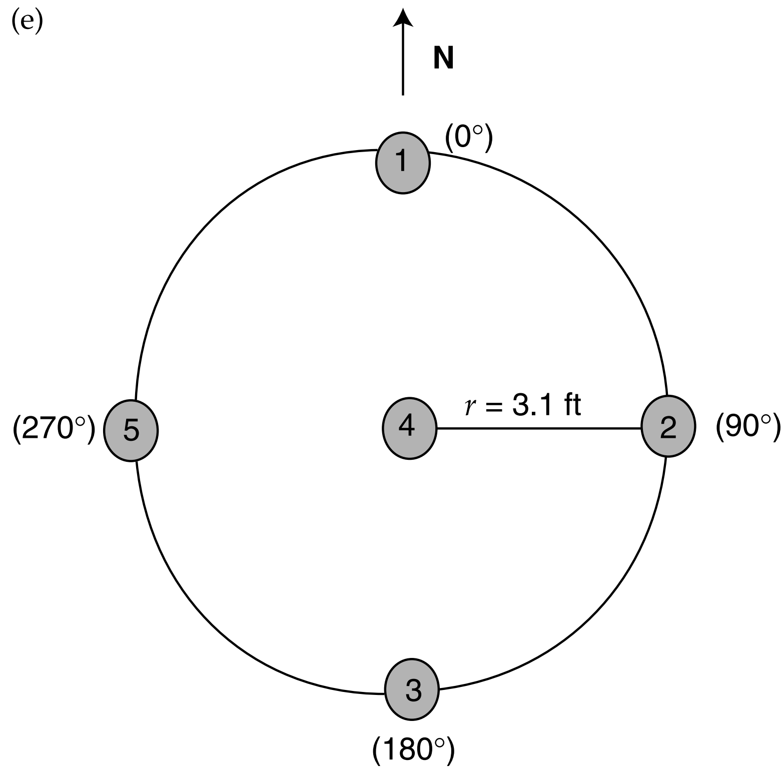


Figure 2 (cont'd). Sensor array configurations for (e) ARL's five-acoustic circular array mounted on the M113.

5. Sensor Arrays With Signature Data in ARL's Database

Table 3 lists the sensor arrays and run numbers that have signature data in ARL's acoustic/seismic database.

Table 3. Arrays with signature data.

Run numbers	Sensor arrays
1 to 25	1,2,5,6,7,8
26 to 28	1,2,3,5,6,7,8
30 to 32	1,2,3,5,6,7
31	2,6,7
33 to 40	3,5,6,7
41 to 43	3,5,7
45 to 61	1,2,3,5,6,7
68 to 71	1,2,3,5,6,7
73 to 77	1,2,5,6,7
78 to 81	1,2,6,7
83	1,7
84	1,6,7
85	6,7
201 to 207	9

6. Run Descriptions

Table 4 lists the log for runs with sensor arrays on the ground. Runs with the array on the M113 are listed in table 5.

Table 4. Runs with sensor arrays on ground.

Date	Run No.	Start (GMT)	End (GMT)	Target	Speed (kph)	Gear	RPM	Spacing (m)	Path
9/22/99	1	21:37:36	21:39:20	Target 1	10	2nd	—	—	2
9/22/99	2	21:39:25	21:45:29	Target 1	15	2nd	—	—	2
9/22/99	3	21:50:32	21:54:48	Target 1	20	2nd	—	—	2
9/22/99	4	21:54:54	21:58:18	Target 1	25	2nd	—	—	2
9/22/99	5	22:00:04	22:05:34	Target 1	10	2nd	—	—	2
9/22/99	6	22:05:35	22:10:31	Target 1	15	2nd	—	—	2
9/22/99	7	22:10:32	22:14:38	Target 1	20	2nd	—	—	2
9/22/99	8	22:14:40	22:18:40	Target 1	25	2nd	—	—	2
9/22/99	9	23:35:15	23:41:38	Target 2	15	2nd	1600	—	2
9/22/99	10	23:42:43	23:50:09	Target 2	10	2nd	1400	—	2
9/22/99	11	23:51:38	23:56:23	Target 2	20	2nd	2000	—	2
9/22/99	12	23:57:00	00:01:10	Target 2	25	3rd	1600	—	2
9/23/99	13	00:02:41	00:09:40	Target 2	10	2nd	1400	—	2
9/23/99	14	00:10:15	00:16:00	Target 2	15	2nd	1600	—	2
9/23/99	15	00:16:44	00:21:17	Target 2	20	2nd	2000	—	2
9/23/99	16	00:22:10	00:26:00	Target 2	25	3rd	1600	—	2
9/23/99	17	01:38:45	01:41:38	Target 3	32	2nd	1750	—	2
9/23/99	18	01:42:00	01:53:14	Target 3	40	3rd	1250	—	—
9/23/99	19	01:54:19	01:57:09	Target 3	30	2nd	1700	—	2
9/23/99	20	01:59:02	02:03:10	Target 3	20	2nd	1250	—	2
9/23/99	21	02:29:33	02:39:45	Target 4	10	2nd	1800	—	2
9/23/99	22	02:40:10	02:45:22	Target 4	20	3rd	2800	—	2
9/23/99	23	02:45:52	02:50:08	Target 4	25	4th	2900	—	2
9/23/99	24	02:51:14	02:55:30	Target 4	25	4th	2900	—	2
9/23/99	25	02:56:10	02:59:29	Target 4	30	5th	2700	—	2
9/23/99	26	21:56:22	21:59:40	M60	20	—	—	—	2
9/23/99	27	22:00:02	22:14:00	M60	30	—	—	—	1
9/23/99	28	22:26:31	22:29:12	M60	35	—	—	—	2
9/23/99	30	23:03:03	23:29:24	BTR-80	20	5th	1700	—	1
9/23/99	31	23:30:33	23:33:36	BTR-80	40	5th	1700	—	2
9/24/99	33	00:00:00	00:10:15	T72	10	2nd	1200	—	2
9/24/99	34	00:14:45	00:21:18	T72	15	2nd	2000	—	2
9/24/99	35	00:22:18	00:27:35	T72	20	4th	1400	—	2
9/24/99	36	00:28:53	00:32:49	T72	25	4th	2200	—	2
9/24/99	37	00:48:12	00:57:24	T72	10	2nd	1200	—	2
9/24/99	38	00:59:30	01:06:25	T72	15	2nd	2000	—	2
9/24/99	39	01:09:15	01:14:54	T72	20	4th	1400	—	2
9/24/99	40	01:15:46	01:19:40	T72	25	4th	2200	—	2
9/24/99	41	02:11:42	02:36:02	M1	25	—	1800	—	1
9/24/99	42	02:37:26	02:56:28	M1	35	—	—	—	1
9/24/99	43	02:58:40	03:00:42	M1	45	—	—	—	2
9/24/99	45	21:27:30	21:34:12	BMP2	20	2nd	1800	—	2
9/24/99	46	21:34:40	21:40:00	BMP2	25	2nd	2200	—	2
9/24/99	47	21:40:24	21:45:21	BMP2	30	3rd	1500	—	2
9/24/99	48	21:46:45	21:54:31	BMP2	15	2nd	1400	—	2
9/24/99	49	21:54:51	22:01:18	BMP2	20	2nd	1800	—	2
9/24/99	50	22:01:46	22:07:10	BMP2	25	2nd	2200	—	2
9/24/99	51	22:07:35	22:12:35	BMP2	30	3rd	1500	—	2

Table 4 (cont'd). Runs with sensor arrays on ground.

Date	Run No.	Start (GMT)	End (GMT)	Target	Speed (kph)	Gear	RPM	Spacing (m)	Path
9/24/99	52	22:30:40	22:33:54	M3	25	—	—	—	2
9/24/99	53	22:34:10	22:56:28	M3	25	—	—	—	1
9/24/99	54	22:57:10	23:00:24	M3	25	—	—	—	2
9/24/99	55	23:25:20	23:55:08	MAZ537	25	—	1450	—	1
9/25/99	56	00:09:25	00:24:40	MAZ537	25	—	1450	—	1
9/25/99	57	00:38:50	00:42:05	T62	10	2nd	1200	—	2
9/25/99	58	00:42:36	00:53:30	T62	15	2nd	1500	—	2
9/25/99	59	00:54:40	00:59:10	T62	10	2nd	1200	—	2
9/25/99	60	00:59:50	01:03:10	T62	25	3rd	1600	—	2
9/25/99	61	01:09:12	01:17:00	T62	10	2nd	1300	—	2
9/27/99	68	22:11:05	22:16:08	T62,BMP2	20	3rd, 3rd	1700, 1500	100	—
9/27/99	69	22:17:05	22:20:35	T62,BMP2	30	4th, 3rd	1700, 2600	100	2
9/27/99	70	22:24:35	22:30:28	T62,BMP2	20	3rd, 3rd	1750, 1500	400	2
9/27/99	71	22:30:16	22:34:45	T62,BMP2	30	4th, 3rd	1700, 2600	400	2
9/27/99	73	23:05:33	23:07:30	T62,T72	30	5th, 4th	2000, 1700	100	2
9/27/99	74	23:12:15	23:17:40	T62,T72	20	4th, 3rd	1500, 1500	400	2
9/27/99	75	23:23:00	23:22:33	T62,T72	30	5th, 4th	2000, 1700	400	2
9/28/99	76	00:11:10	00:16:35	T62,T72,	20	3rd, 4th,	1500, 1500	50	2
				BMP2	—	3rd	1700	—	—
9/28/99	77	00:18:15	00:21:40	T62,T72,	20	3rd, 4th,	1500, 1500	50	2
				BMP2	—	3rd	1700	—	—
9/28/99	78	00:25:50	00:30:20	T62,72,	20	3rd, 4th,	1500, 1600	400	2
				BMP2	—	3rd	1700	—	—
9/28/99	79	00:33:30	00:36:35	T62,T72,	30	4th, 5th,	1500, 1950	400	2
				BMP2	—	4th	1800	—	—
9/28/99	80	01:56:59	02:22:34	ZIL,	25	N/A, 4th,	N/A, 1900,	100	1+2
				BTR-80,	—	2nd	1250	—	—
				MAZ537	—	—	—	—	—
9/28/99	81	02:33:06	02:52:20	MAZ537,	35	2nd, 5th	1800, 2000	400	1+2
				BTR-80	—	—	—	—	—
9/28/99	83	21:08:57	21:35:08	M60,M1,M3	25	—	—	—	1+2
9/28/99	84	21:40:59	21:57:45	M60,M1,M3	25	—	—	400	—
9/28/99	85	22:52:23	23:21:06	M1, M3,	25	—	—	100	1+2
				2.5 Ton,	—	—	—	—	—
				CUCV*	—	—	—	—	—

*Commercial utility cargo vehicle

Table 5. Runs with sensor array on M113.

Date	Run No.	Start (GMT)	End (GMT)	M113 engine	Path	Target	Speed (kph)
9/23/99	201	16:49:45	16:52:58	on	2	M60	35
9/23/99	202	16:53:47	16:56:20	on	2	M60	35
9/23/99	203	16:57:18	16:59:54	off	2	M60	35
9/23/99	204	19:01:23	19:04:25	on	2	M60	32
9/23/99	205	19:05:23	19:08:41	on	2	M60	24
9/23/99	206	19:10:08	19:13:02	off	2	M60	32
9/23/99	207	19:13:18	19:16:23	off	2	M60	24

7. Conclusion

The field experiment proved to be a success. The new-generation sensors performed well and will be used to replace the digital audio tape recorders in data acquisition and the outdated Kontron-based sensors in real-time signal processing. Collecting the acoustic/seismic signatures in digital format eliminates the task of downloading data from tapes. This greatly expedites the process of populating the acoustic/seismic database and makes acoustic data more accessible to the acoustic community.

Currently, all ARL's acoustic arrays are stationary and placed on the ground. ARL will experiment with placing an array on a moving/idling vehicle. This will mark the start of the study of platform noise reduction. To support the research and development in this area of acoustics, ARL will need signatures of targets collected by an array on board a vehicle as well as signatures of the platform itself. Future field tests will also provide opportunities to evaluate modifications to the new-generation sensors.

Appendix. Meteorological Data

These tables include meteorological data necessary for properly evaluating the acoustic data gathered by ground sensors during the DUNES experiment.

Meteorological data from DUNES experiment for 9/21/99 at 1900 EDT.

Altitude (m above surface)	Temp (°C)	RH (%)	Press (mbar)	Wind speed (m/s)	Wind direct (°)
0	12.85	93	1009.8	7.20	334
2	12.75	92	1009.6	7.32	334
10	12.75	90	1008.6	7.77	336
30	12.65	85	1006.2	8.93	339
50	12.45	82	1003.8	9.88	342
70	12.25	83	1001.4	10.39	344
100	11.95	83	997.8	11.00	346
130	11.55	84	994.2	11.41	348
160	11.25	86	990.7	11.56	350
200	10.75	87	986.0	11.52	352
230	10.55	88	982.4	11.45	352
260	10.25	88	978.8	11.42	353
300	9.85	89	974.2	11.57	354
350	9.45	91	968.4	12.01	355
400	9.15	91	962.6	12.83	359
450	8.95	92	956.8	13.98	2
500	8.85	92	951.0	14.88	4
600	9.75	92	939.6	14.79	12
700	10.75	91	928.4	12.74	13
800	10.15	89	917.4	12.20	7
900	9.65	87	906.4	12.50	357
1000	9.55	87	895.6	12.00	356

Meteorological data from DUNES experiment for 9/22/99 at 2100 EDT.

Altitude (m above surface)	Temp (°C)	RH (%)	Press (mbar)	Wind speed (m/s)	Wind direct (°)
0	15.0	57	1008.7	0.6	290
2	14.9	56	1008.5	1.5	292
10	14.7	54	1007.5	2.3	297
30	14.2	50	1005.2	2.8	297
50	14.0	49	1002.8	3.4	306
70	13.9	48	1000.4	3.7	307
100	13.7	46	996.9	4.4	315
130	13.6	45	993.2	5.0	320
160	13.5	43	989.7	5.3	327
200	13.4	42	985.0	6.2	332
230	13.3	41	981.5	7.1	335
260	13.0	41	978.0	9.2	333
300	12.6	41	973.4	10.1	334
350	12.3	41	967.6	10.4	335
400	11.9	41	961.8	10.8	335
450	11.6	40	956.1	11.5	336
500	11.2	42	950.4	12.1	333
600	10.5	43	939.1	12.0	330
700	9.7	46	927.8	12.4	328
800	8.9	47	916.6	13.0	329
900	8.0	49	905.6	13.7	329
1000	7.0	50	894.7	14.7	329

Meteorological data from DUNES experiment for 9/23/99 at 2300 EDT.

Altitude (m above surface)	Temp (°C)	RH (%)	Press (mbar)	Wind speed (m/s)	Wind direct (°)
0	17.3	75	1013.3	1.0	189
2	17.3	74	1013.1	3.3	190
10	17.5	72	1012.1	3.7	194
30	18.1	63	1009.9	4.8	213
50	18.1	60	1007.5	6.2	216
70	18.2	59	1005.2	6.8	212
100	18.5	57	1001.7	7.7	210
130	18.8	52	998.3	8.5	212
160	19.2	44	994.8	9.1	212
200	19.4	41	990.1	9.3	213
230	19.4	37	986.7	13.5	216
260	19.2	35	983.3	13.9	218
300	19.1	33	978.5	14.1	219
350	18.7	36	972.8	13.8	221
400	18.3	37	967.3	13.4	223
450	17.9	38	961.5	13.5	226
500	17.5	39	956.1	13.8	231
600	16.5	41	944.9	13.1	234
700	15.6	44	933.9	13.2	239
800	15.0	44	922.9	13.1	242
900	16.6	11	912.1	11.6	240
1000	16.5	15	901.4	10.2	236

Meteorological data from DUNES experiment for 9/24/99 at 2100 EDT.

Altitude (m above surface)	Temp (°C)	RH (%)	Press (mbar)	Wind speed (m/s)	Wind direct (°)
0	16.1	84	1012.6	0.3	165
2	16.2	83	1012.4	1.8	172
10	16.7	79	1011.4	3.9	180
30	17.7	68	1009.0	5.4	201
50	18.2	61	1006.7	5.9	199
70	18.2	60	1004.3	6.6	200
100	18.0	59	1000.7	8.0	198
130	18.1	57	997.4	9.4	198
160	18.9	54	993.7	10.7	199
200	20.3	47	989.1	12.2	204
230	21.5	42	985.7	15.0	206
260	21.3	39	982.3	15.5	206
300	21.2	39	977.8	14.7	212
350	20.8	39	972.1	13.2	216
400	20.7	38	966.5	12.5	218
450	20.3	38	960.8	12.2	220
500	19.9	39	955.5	12.3	222
600	19.1	41	944.3	12.4	226
700	18.3	41	933.5	12.3	225
800	17.5	42	922.6	12.9	229
900	16.3	45	911.9	12.7	228
1000	15.4	48	901.0	11.7	234

Meteorological data from DUNES experiment for 9/27/99 at 2300 EDT.

Altitude (m above surface)	Temp (°C)	RH (%)	Press (mbar)	Wind speed (m/s)	Wind direct (°)
0	20.45	94	1024.4	0.10	104
2	20.45	93	1024.2	0.70	110
10	20.35	88	1023.2	1.00	121
30	20.25	81	1020.9	1.20	124
50	20.15	82	1018.6	1.60	127
70	20.05	83	1016.2	2.10	125
100	19.95	83	1012.6	3.20	132
130	19.85	82	1009.1	5.60	140
160	19.75	82	1005.6	5.80	148
200	20.15	79	1001.0	6.20	158
230	20.45	77	997.6	6.90	168
260	20.65	77	994.1	7.60	174
300	20.65	78	989.5	7.60	181
350	20.55	79	983.8	7.60	187
400	20.15	80	978.1	8.00	192
450	19.95	77	972.5	8.50	195
500	19.55	75	966.9	8.86	198
600	19.15	79	955.8	9.04	200
700	18.55	77	944.6	9.02	201
800	17.85	75	933.8	9.09	198
900	17.05	76	922.9	8.66	193
1000	16.45	73	912.2	8.40	189

Meteorological data from DUNES experiment for 9/28/99 at 2200 EDT.

Altitude (m above surface)	Temp (°C)	RH (%)	Press (mbar)	Wind speed (m/s)	Wind direct (°)
0	20.45	94	1024.4	0.3	173
2	20.45	93	1024.2	1.3	179
10	20.35	88	1023.2	2.3	185
30	20.25	81	1020.9	3.1	191
50	20.15	82	1018.6	3.8	201
70	20.05	83	1016.2	4.0	198
100	19.95	83	1012.6	4.8	198
130	19.85	82	1009.1	5.0	201
160	19.75	82	1005.6	5.9	209
200	20.15	79	1001.0	7.2	198
230	20.45	77	997.6	7.5	187
260	20.65	77	994.1	7.6	183
300	20.65	78	989.5	7.6	181
350	20.55	79	983.8	7.6	187
400	20.15	80	978.1	8.0	192
450	19.95	77	972.5	8.5	195
500	19.55	75	966.9	8.9	198
600	19.15	79	955.8	9.0	200
700	18.55	77	944.6	9.0	201
800	17.85	75	933.8	9.1	198
900	17.05	76	922.9	8.7	193
1000	16.45	73	912.2	8.4	189

Meteorological data from DUNES experiment for 9/29/99 at 1800 EDT.

Altitude (m above surface)	Temp (°C)	RH (%)	Press (mbar)	Wind speed (m/s)	Wind direct (°)
0	22.8	75	1011.5	0.2	161
2	22.7	75	1011.3	1.7	166
10	22.7	72	1010.4	1.9	171
30	22.3	65	1008.1	2.8	179
50	22.1	62	1005.7	3.5	168
70	22.0	62	1003.4	4.7	165
100	21.9	62	999.9	5.2	162
130	21.8	62	996.6	6.0	159
160	21.7	60	993.1	5.6	157
200	21.7	59	988.5	6.6	156
230	21.7	59	985.1	6.6	161
260	21.5	59	981.7	6.9	166
300	21.1	59	977.2	7.4	165
350	20.7	61	971.5	7.6	162
400	20.3	62	966.0	7.7	162
450	19.8	63	960.4	7.5	161
500	19.3	65	954.8	7.5	160
600	18.4	67	943.9	7.7	159
700	17.4	71	932.8	7.7	159
800	16.5	75	922.0	7.7	161
900	15.7	79	911.3	8.0	166
1000	15.0	78	900.5	8.8	171

Meteorological data from DUNES experiment for 9/30/99 at 2100 EDT.

Altitude (m above surface)	Temp (°C)	RH (%)	Press (mbar)	Wind speed (m/s)	Wind direct (°)
0	14.05	70	1014.0	0.30	245
2	14.15	68	1013.8	2.00	246
10	14.55	61	1012.8	2.60	248
30	15.75	44	1010.4	5.70	261
50	16.65	33	1008.0	6.80	276
70	17.15	32	1005.6	7.60	277
100	17.35	30	1002.1	5.90	284
130	17.15	29	998.6	8.00	264
160	16.85	29	995.1	8.90	269
200	16.45	29	990.4	9.31	276
230	16.25	30	986.9	8.83	281
260	15.95	30	983.4	8.53	285
300	15.65	30	978.7	8.60	290
350	15.25	31	972.9	8.31	292
400	14.75	31	967.3	8.20	293
450	14.35	32	961.6	8.24	296
500	13.85	33	955.9	8.35	298
600	12.95	34	944.5	8.60	301
700	12.05	36	933.4	8.49	302
800	11.05	38	922.3	8.92	303
900	10.05	40	911.3	9.03	305
1000	9.15	41	900.3	9.04	308

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13. ABSTRACT *(Maximum 200 words)*
Field experiments are crucial in developing and evaluating acoustic sensors for target detection, direction finding, classification, and identification. The U.S. Army Research Laboratory (ARL) regularly conducts field experiments to demonstrate and evaluate real-time performance of the acoustic sensor test bed and to collect signature data of new targets for an ARL acoustic and seismic database. During 20 to 30 September 1999, ARL conducted a field experiment on Spesutie Island, Aberdeen Proving Ground, Maryland, as part of the Distributed Unattended Networked Sensors (DUNES) program. The main objectives of this experiment were to demonstrate the advances of the new generation of acoustic sensors and to collect data of new targets. This report documents the field test log, sensor array descriptions, and meteorological data from that experiment.

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