



AGENȚIA DE CERCETARE PENTRU  
TEHNICĂ ȘI TEHNOLOGII MILITARE

## SISTEM DE IDENTIFICARE SI LOCALIZARE PRIN AER SI SOL A POZITIEI GURILOR DE FOC INCAMPURI DE TRAGERE (GUNDETECT)

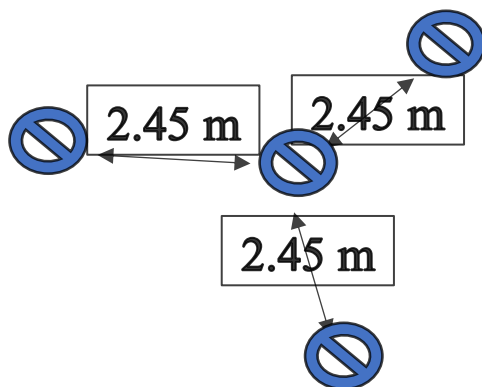
**Activitatea 2 - Realizarea, testarea instalatiei “Infrasound Array”. Elaborarea metodelor, soluțiilor și procedurilor pentru evenimentele infrasonice generate de arme în zonele beligerante.**

**Activitate 2.4 Instalarea si testarea in situ a echipamentelor si subansamblelor care alcatuiesc instalatia pilot.**

### REZULTATE EXPERIMENTALE

Au fost efectuate mai multe teste pe teren în aer liber cu sistemele de tip prototip. Principalele atribute care au impus testele si pentru a caracteriza performanța sistemelor descries: (1) distanța de detectare a surselor de infrasunete; și (2) capacitatea de identificare a azimutului unde a avut loc evenimentul. Testele au fost efectuate în aer liber, într-o zona libera de activitati umane.

Distanța de detectare. Pentru inceput am incercat sa testam prototipurile pentru a observa capacitatea de inregistrare si de fiabilitate in teren. Scopul colectării de date a fost de a determina distanțele maxime la care sistemul nostru ar putea detecta explozii, in cazul nostru generate de petarde. Intensitatea semnalului produs de petarde a fost măsurată la fața locului folosind un accelerometru de tip ETNA2.



Nume canal/sensor BDF	Lat	Long
RP0	44.362407	25.935524
RP1	44.362399	25.935594
RP2	44.362393	25.935547
RP3	44.362426	25.935536

Fig. Disponerea senzorilor “Raspberry Shake and Boom” in teren

Microfoane		
Nume canal/sensor BDF	Lat	Long
GUN1	44.362448	25.935591
GUN2	44.362449	25.935590
GUN3	44.362450	25.935590
GUN4	44.362451	25.935591
GUN5	44.362452	25.935592
GUN6	44.362450	25.935595
GUN7	44.362449	25.935596
GUN8	44.362448	25.935598

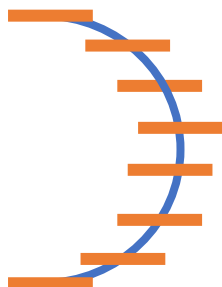


Fig. Disponerea senzorilor “Microfon” in teren

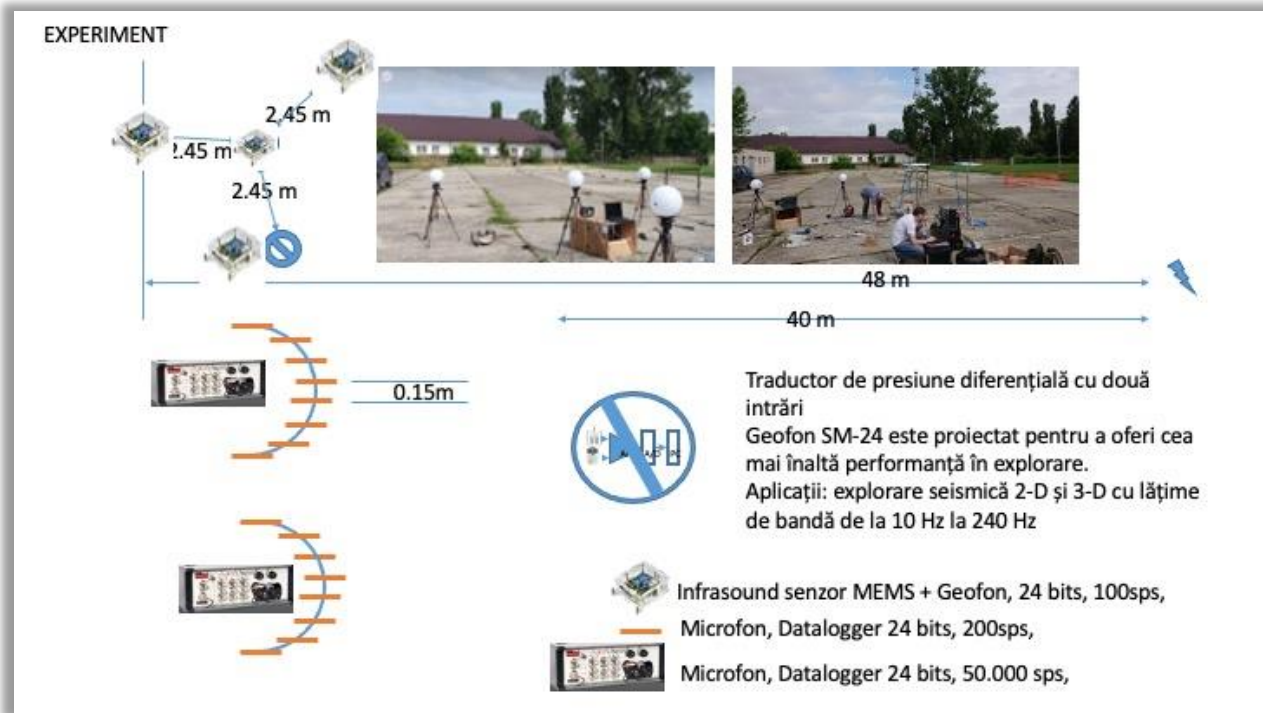
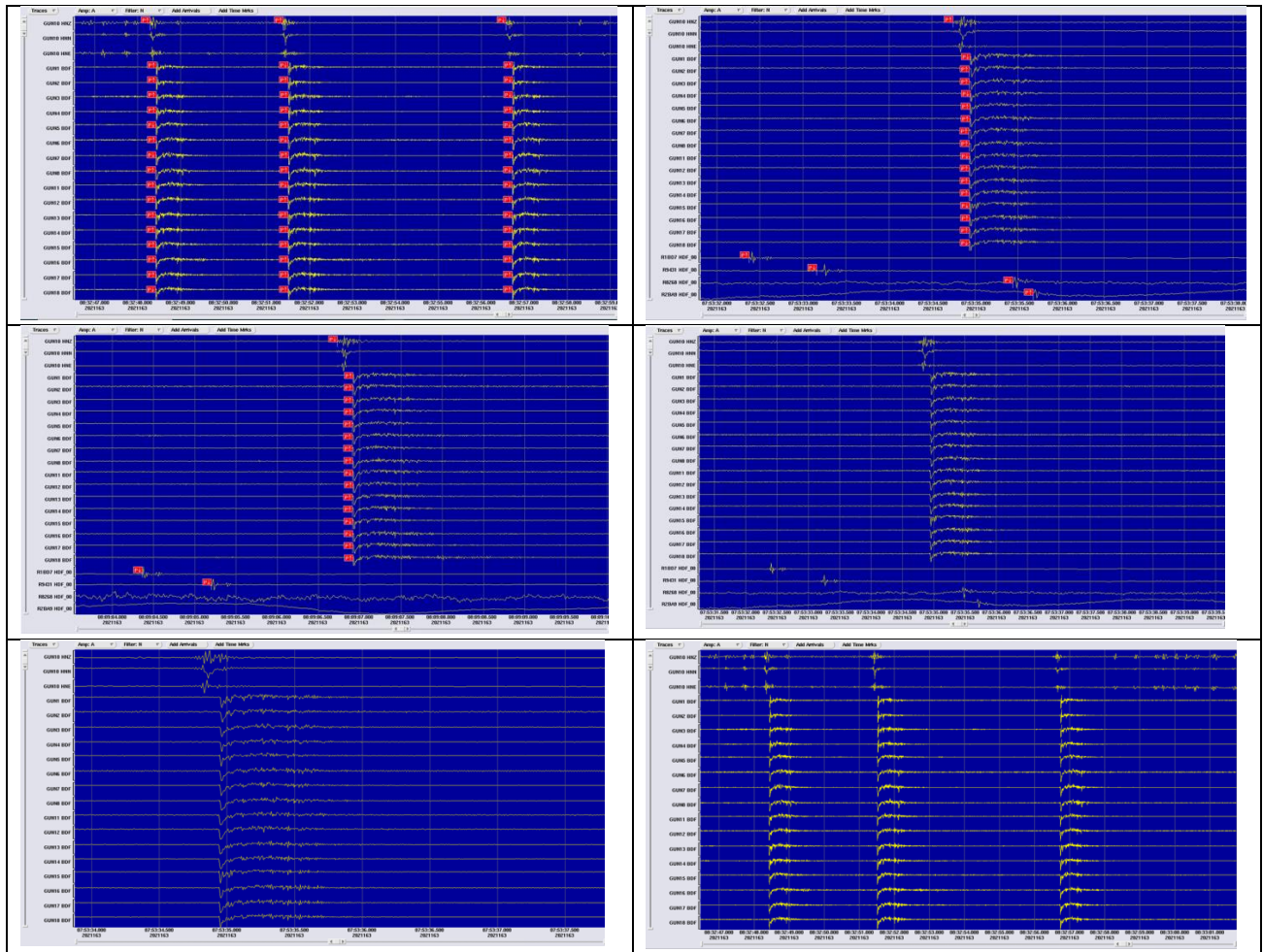


Fig- Experiment de identificare sursa de tip explozie

Cum terenul pus la dispozitie era mic, distanta dintre sursa si inregistratoare a fost de cca 50 m, am realizat diverse configuratii pentru prototipurile realizate pentru a confirma că datele generate de exploziile petardelor erau vizibile în mod constant pe sistemele de inregistrare. S-au efectuat mai multe teste prin mutarea locului exploziei dar si prin schimbarea configuratiei senzorilor utilizati.

După ce au fost colectate mai multe eșantioane de date, acesta a fost analize pentru aflarea direcției si distantei de unde s-a generat semnalul, rezultând o estimare direcțională a sursei. Pentru comparatii si estimari aleatorii am mutat sursa acustică în locații diferite de pe același loc pentru a varia direcția. Mai jos prezentam formele de unda si dispunerea in teren a echipamentelor de tip prototip.





Forme de unda inregistrate pe perioada testelor

Tabel cu datele inregistrare

Senzor	Data	Ora	Canal	iphase	fm	auth	Senzor	Data	Ora	Canal	iphase	fm	auth
GUN1	6/12/2021	7:49:49.650	BDF	P	d.	dbprt:21250	GUN1	6/12/2021	7:53:34.949	BDF	P	d.	dbprt:21250
GUN10	6/12/2021	7:49:49.509	HNZ	P	d.	dbprt:21250	GUN10	6/12/2021	7:53:34.746	HNZ	P	c.	dbprt:21250
GUN11	6/12/2021	7:49:49.655	BDF	P	d.	dbprt:21250	GUN11	6/12/2021	7:53:34.938	BDF	P	d.	dbprt:21250
GUN12	6/12/2021	7:49:49.656	BDF	P	c.	dbprt:21250	GUN12	6/12/2021	7:53:34.935	BDF	P	c.	dbprt:21250
GUN13	6/12/2021	7:49:49.655	BDF	P	c.	dbprt:21250	GUN13	6/12/2021	7:53:34.935	BDF	P	c.	dbprt:21250
GUN14	6/12/2021	7:49:49.655	BDF	P	c.	dbprt:21250	GUN14	6/12/2021	7:53:34.935	BDF	P	c.	dbprt:21250
GUN15	6/12/2021	7:49:49.665	BDF	P	d.	dbprt:21250	GUN15	6/12/2021	7:53:34.940	BDF	P	d.	dbprt:21250
GUN16	6/12/2021	7:49:49.655	BDF	P	d.	dbprt:21250	GUN16	6/12/2021	7:53:34.939	BDF	P	c.	dbprt:21250
GUN17	6/12/2021	7:49:49.664	BDF	P	c.	dbprt:21250	GUN17	6/12/2021	7:53:34.935	BDF	P	c.	dbprt:21250
GUN18	6/12/2021	7:49:49.660	BDF	P	d.	dbprt:21250	GUN18	6/12/2021	7:53:34.935	BDF	P	d.	dbprt:21250
GUN2	6/12/2021	7:49:49.656	BDF	P	c.	dbprt:21250	GUN2	6/12/2021	7:53:34.934	BDF	P	c.	dbprt:21250
GUN3	6/12/2021	7:49:49.655	BDF	P	c.	dbprt:21250	GUN3	6/12/2021	7:53:34.934	BDF	P	c.	dbprt:21250
GUN4	6/12/2021	7:49:49.655	BDF	P	d.	dbprt:21250	GUN4	6/12/2021	7:53:34.946	BDF	P	d.	dbprt:21250
GUN5	6/12/2021	7:49:49.651	BDF	P	c.	dbprt:21250	GUN5	6/12/2021	7:53:34.942	BDF	P	c.	dbprt:21250
GUN6	6/12/2021	7:49:49.651	BDF	P	c.	dbprt:21250	GUN6	6/12/2021	7:53:34.942	BDF	P	c.	dbprt:21250
GUN7	6/12/2021	7:49:49.651	BDF	P	c.	dbprt:21250	GUN7	6/12/2021	7:53:34.930	BDF	P	c.	dbprt:21250
GUN8	6/12/2021	7:49:49.650	BDF	P	d.	dbprt:21250	GUN8	6/12/2021	7:53:34.934	BDF	P	c.	dbprt:21250
							R1B07	6/12/2021	7:53:32.376	HDF_00	P	c.	dbprt:21250
							R2BA9	6/12/2021	7:53:35.678	HDF_00	P	c.	dbprt:21250
							R8268	6/12/2021	7:53:35.440	HDF_00	P	d.	dbprt:21250
							R9431	6/12/2021	7:53:33.164	HDF_00	P	d.	dbprt:21250

Senzor	Data	Ora	Canal	iphase	fm	auth	Senzor	Data	Ora	Canal	iphase	fm	auth
GUN1	6/12/2021	8:01:51.475	BDF	P	c.	dbprt:21250	GUN1	6/12/2021	8:09:06.919	BDF	P	c.	dbprt:21250
GUN10	6/12/2021	8:01:51.306	HNZ	P	c.	dbprt:21250	GUN10	6/12/2021	8:09:06.729	HNZ	P	d.	dbprt:21250
GUN11	6/12/2021	8:01:51.441	BDF	P	d.	dbprt:21250	GUN11	6/12/2021	8:09:06.914	BDF	P	d.	dbprt:21250
GUN12	6/12/2021	8:01:51.457	BDF	P	d.	dbprt:21250	GUN12	6/12/2021	8:09:06.918	BDF	P	c.	dbprt:21250
GUN13	6/12/2021	8:01:51.462	BDF	P	c.	dbprt:21250	GUN13	6/12/2021	8:09:06.910	BDF	P	c.	dbprt:21250
GUN14	6/12/2021	8:01:51.465	BDF	P	c.	dbprt:21250	GUN14	6/12/2021	8:09:06.908	BDF	P	c.	dbprt:21250
GUN15	6/12/2021	8:01:51.462	BDF	P	d.	dbprt:21250	GUN15	6/12/2021	8:09:06.914	BDF	P	d.	dbprt:21250
GUN16	6/12/2021	8:01:51.465	BDF	P	d.	dbprt:21250	GUN16	6/12/2021	8:09:06.914	BDF	P	d.	dbprt:21250
GUN17	6/12/2021	8:01:51.462	BDF	P	d.	dbprt:21250	GUN17	6/12/2021	8:09:06.916	BDF	P	c.	dbprt:21250
GUN18	6/12/2021	8:01:51.468	BDF	P	c.	dbprt:21250	GUN18	6/12/2021	8:09:06.918	BDF	P	c.	dbprt:21250
GUN2	6/12/2021	8:01:51.470	BDF	P	c.	dbprt:21250	GUN2	6/12/2021	8:09:06.914	BDF	P	c.	dbprt:21250
GUN3	6/12/2021	8:01:51.468	BDF	P	c.	dbprt:21250	GUN3	6/12/2021	8:09:06.912	BDF	P	c.	dbprt:21250
GUN4	6/12/2021	8:01:51.465	BDF	P	d.	dbprt:21250	GUN4	6/12/2021	8:09:06.916	BDF	P	c.	dbprt:21250
GUN5	6/12/2021	8:01:51.470	BDF	P	c.	dbprt:21250	GUN5	6/12/2021	8:09:06.910	BDF	P	c.	dbprt:21250
GUN6	6/12/2021	8:01:51.470	BDF	P	c.	dbprt:21250	GUN6	6/12/2021	8:09:06.908	BDF	P	c.	dbprt:21250
GUN7	6/12/2021	8:01:51.475	BDF	P	d.	dbprt:21250	GUN7	6/12/2021	8:09:06.910	BDF	P	c.	dbprt:21250
GUN8	6/12/2021	8:01:51.470	BDF	P	c.	dbprt:21250	GUN8	6/12/2021	8:09:06.912	BDF	P	c.	dbprt:21250
							R1BD7	6/12/2021	8:09:04.361	HDF_00	P	d.	dbprt:21250
							R9431	6/12/2021	8:09:05.201	HDF_00	P	d.	dbprt:21250
Senzor	Data	Ora	Canal	iphase	fm	auth	Senzor	Data	Ora	Canal	iphase	fm	auth
GUN1	6/12/2021	8:30:07.828	BDF	P	c.	dbprt:21250	GUN1	6/12/2021	8:31:36.313	BDF	P	d.	dbprt:21250
GUN10	6/12/2021	8:30:07.685	HNZ	P	c.	dbprt:21250	GUN10	6/12/2021	8:31:36.220	HNZ	P	d.	dbprt:21250
GUN11	6/12/2021	8:30:07.817	BDF	P	c.	dbprt:21250	GUN11	6/12/2021	8:31:36.298	BDF	P	c.	dbprt:21250
GUN12	6/12/2021	8:30:07.817	BDF	P	c.	dbprt:21250	GUN12	6/12/2021	8:31:36.300	BDF	P	c.	dbprt:21250
GUN13	6/12/2021	8:30:07.815	BDF	P	c.	dbprt:21250	GUN13	6/12/2021	8:31:36.298	BDF	P	c.	dbprt:21250
GUN14	6/12/2021	8:30:07.819	BDF	P	c.	dbprt:21250	GUN14	6/12/2021	8:31:36.298	BDF	P	c.	dbprt:21250
GUN15	6/12/2021	8:30:07.821	BDF	P	d.	dbprt:21250	GUN15	6/12/2021	8:31:36.303	BDF	P	c.	dbprt:21250
GUN16	6/12/2021	8:30:07.822	BDF	P	d.	dbprt:21250	GUN16	6/12/2021	8:31:36.303	BDF	P	c.	dbprt:21250
GUN17	6/12/2021	8:30:07.822	BDF	P	c.	dbprt:21250	GUN17	6/12/2021	8:31:36.302	BDF	P	c.	dbprt:21250
GUN18	6/12/2021	8:30:07.823	BDF	P	d.	dbprt:21250	GUN18	6/12/2021	8:31:36.303	BDF	P	c.	dbprt:21250
GUN2	6/12/2021	8:30:07.828	BDF	P	c.	dbprt:21250	GUN2	6/12/2021	8:31:36.304	BDF	P	d.	dbprt:21250
GUN3	6/12/2021	8:30:07.830	BDF	P	c.	dbprt:21250	GUN3	6/12/2021	8:31:36.312	BDF	P	d.	dbprt:21250
GUN4	6/12/2021	8:30:07.834	BDF	P	c.	dbprt:21250	GUN4	6/12/2021	8:31:36.313	BDF	P	c.	dbprt:21250
GUN5	6/12/2021	8:30:07.827	BDF	P	d.	dbprt:21250	GUN5	6/12/2021	8:31:36.308	BDF	P	c.	dbprt:21250
GUN6	6/12/2021	8:30:07.828	BDF	P	c.	dbprt:21250	GUN6	6/12/2021	8:31:36.307	BDF	P	c.	dbprt:21250
GUN7	6/12/2021	8:30:07.827	BDF	P	c.	dbprt:21250	GUN7	6/12/2021	8:31:36.306	BDF	P	c.	dbprt:21250
GUN8	6/12/2021	8:30:07.826	BDF	P	c.	dbprt:21250	GUN8	6/12/2021	8:31:36.308	BDF	P	c.	dbprt:21250
Senzor	Data	Ora	Canal	iphase	fm	auth	Senzor	Data	Ora	Canal	iphase	fm	auth
GUN1	6/12/2021	8:32:48.434	BDF	P	c.	dbprt:21250	GUN1	6/12/2021	8:32:51.508	BDF	P	d.	dbprt:21250
GUN10	6/12/2021	8:32:48.290	HNZ	P	c.	dbprt:21250	GUN10	6/12/2021	8:32:51.386	HNZ	P	c.	dbprt:21250
GUN11	6/12/2021	8:32:48.416	BDF	P	c.	dbprt:21250	GUN11	6/12/2021	8:32:51.501	BDF	P	d.	dbprt:21250
GUN12	6/12/2021	8:32:48.416	BDF	P	c.	dbprt:21250	GUN12	6/12/2021	8:32:51.499	BDF	P	c.	dbprt:21250
GUN13	6/12/2021	8:32:48.416	BDF	P	c.	dbprt:21250	GUN13	6/12/2021	8:32:51.499	BDF	P	c.	dbprt:21250
GUN14	6/12/2021	8:32:48.419	BDF	P	c.	dbprt:21250	GUN14	6/12/2021	8:32:51.503	BDF	P	c.	dbprt:21250
GUN15	6/12/2021	8:32:48.421	BDF	P	c.	dbprt:21250	GUN15	6/12/2021	8:32:51.503	BDF	P	c.	dbprt:21250
GUN16	6/12/2021	8:32:48.423	BDF	P	c.	dbprt:21250	GUN16	6/12/2021	8:32:51.501	BDF	P	c.	dbprt:21250
GUN17	6/12/2021	8:32:48.421	BDF	P	c.	dbprt:21250	GUN17	6/12/2021	8:32:51.504	BDF	P	c.	dbprt:21250
GUN18	6/12/2021	8:32:48.419	BDF	P	d.	dbprt:21250	GUN18	6/12/2021	8:32:51.503	BDF	P	c.	dbprt:21250
GUN2	6/12/2021	8:32:48.430	BDF	P	c.	dbprt:21250	GUN2	6/12/2021	8:32:51.508	BDF	P	c.	dbprt:21250
GUN3	6/12/2021	8:32:48.431	BDF	P	c.	dbprt:21250	GUN3	6/12/2021	8:32:51.512	BDF	P	c.	dbprt:21250
GUN4	6/12/2021	8:32:48.430	BDF	P	c.	dbprt:21250	GUN4	6/12/2021	8:32:51.512	BDF	P	c.	dbprt:21250
GUN5	6/12/2021	8:32:48.421	BDF	P	d.	dbprt:21250	GUN5	6/12/2021	8:32:51.506	BDF	P	c.	dbprt:21250
GUN6	6/12/2021	8:32:48.430	BDF	P	c.	dbprt:21250	GUN6	6/12/2021	8:32:51.504	BDF	P	d.	dbprt:21250
GUN7	6/12/2021	8:32:48.420	BDF	P	d.	dbprt:21250	GUN7	6/12/2021	8:32:51.510	BDF	P	c.	dbprt:21250
GUN8	6/12/2021	8:32:48.419	BDF	P	c.	dbprt:21250	GUN8	6/12/2021	8:32:51.510	BDF	P	c.	dbprt:21250
Senzor	Data	Ora	Canal	iphase	fm	auth	Tabel cu timpii de sosire ai unei generate de explozii la senzorii utilizatii in cele 9 experimente. GUN1- Nume canal/senzor BDF- conventie utilizata in denumirea canalelor pentru senzorii de infasunete HNZ, E, N- conventie utilizata in denumirea canalelor de acceleratie P- prima sosire, faza primara c,d – compresie sau dilatare						
GUN1	6/12/2021	8:32:56.731	BDF	P	c.	dbprt:21250							
GUN10	6/12/2021	8:32:56.577	HNZ	P	d.	dbprt:21250							
GUN11	6/12/2021	8:32:56.721	BDF	P	d.	dbprt:21250							
GUN12	6/12/2021	8:32:56.720	BDF	P	c.	dbprt:21250							
GUN13	6/12/2021	8:32:56.721	BDF	P	d.	dbprt:21250							
GUN14	6/12/2021	8:32:56.721	BDF	P	c.	dbprt:21250							
GUN15	6/12/2021	8:32:56.723	BDF	P	c.	dbprt:21250							
GUN16	6/12/2021	8:32:56.724	BDF	P	c.	dbprt:21250							
GUN17	6/12/2021	8:32:56.721	BDF	P	c.	dbprt:21250							
GUN18	6/12/2021	8:32:56.721	BDF	P	c.	dbprt:21250							
GUN2	6/12/2021	8:32:56.729	BDF	P	d.	dbprt:21250							
GUN3	6/12/2021	8:32:56.729	BDF	P	d.	dbprt:21250							
GUN4	6/12/2021	8:32:56.731	BDF	P	c.	dbprt:21250							
GUN5	6/12/2021	8:32:56.724	BDF	P	d.	dbprt:21250							
GUN6	6/12/2021	8:32:56.726	BDF	P	c.	dbprt:21250							
GUN7	6/12/2021	8:32:56.726	BDF	P	c.	dbprt:21250							
GUN8	6/12/2021	8:32:56.724	BDF	P	d.	dbprt:21250							

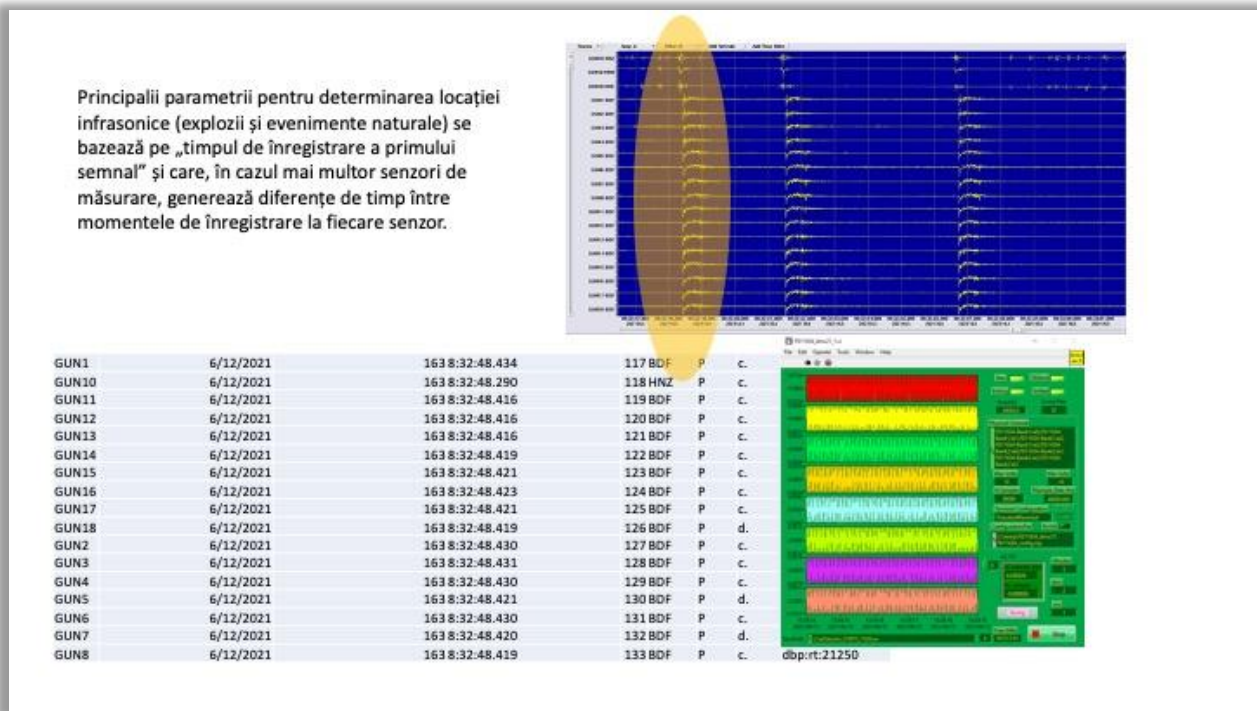


Fig. Primele rezultate

## CONCLUZII

În testele experimentale, am reușit să confirmăm că sistemele de tip prototip, utilizând atât senzori de infrasunete cât și microfoane este fiabil și capabil să detecteze exploziile produse la suprafața solului prin identificarea semnalului, direcției și distanței. Principala deficiență observată este timpul de instalare și suprafața pe care o ocupă sistemul pentru a putea pune în funcțiune și apoi de a identifica sursa de semnal. În acest sens s-a dispus achiziția a unui înregistrator de 24 biți, 8 canale, sistem de alimentare cu 24 Vcc în vederea realizării unui sistem portabil care să fie instalat pe o mașină sau alt sistem motorizat. Pentru confirmare și redundanță am achiziționat 4 digitizoare seismice de 24 biți, 3ch pentru a crea un sistem de detecție a infrasunetelor fix care se instalează în spatele liniilor de foc și care folosește senzori profesioniști de infrasunete cu dimensiuni reduse.

## Bibliografie

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