

SPOOFERS REVEALED

We show those satellites that are:

Tracked

Used

Spoofed

Blocked/Jammed

Faked

Replaced



See details inside

Spoofers are not only of the Black Sea type, as reported in the press, kids are going that direction too. It is time to take spoofers seriously.

Spoofers are completely different from jammers that block GNSS signals. Spoofers create GNSS-like signals that fool receivers to provide false location solutions.

We combat spoofers in two ways:

- 1 Detect and alarm that spoofer exist. Then distinguish the spoofer signal, ignore it, and use valid satellite signals.
- 2 Help find the direction that spoofed signals are coming from.

**Spoofers detection is available
in all of our OEM boards too.**

“Why Javad?”

Because it works where nothing else will and it has abilities and features that nothing else does.”



“Truly amazing with a 4” grape vine directly overhead and the tree cover.”



“I got some ridiculous ‘fixes’ today in some horrible situations. Reset receiver, moved around, etc. Tried to get a bad fix but had a hard time doing it.”



“This thing is bad ass!”

“I had 100% confidence this RTK was good. As soon as I stored the shot I inverted to my design point at that location and got 0.06’. No second PPK necessary! Then for the cherry on top, I processed the PPK at the office at it was 0.05’ from the RTK I stored. Just an amazing Surveying machine!”



The LS has increased our productivity 2:1

“Thank you for the most awesome set of equipment I have had the pleasure of running in my 41 years of surveying. I am having the most fun I have ever had!”



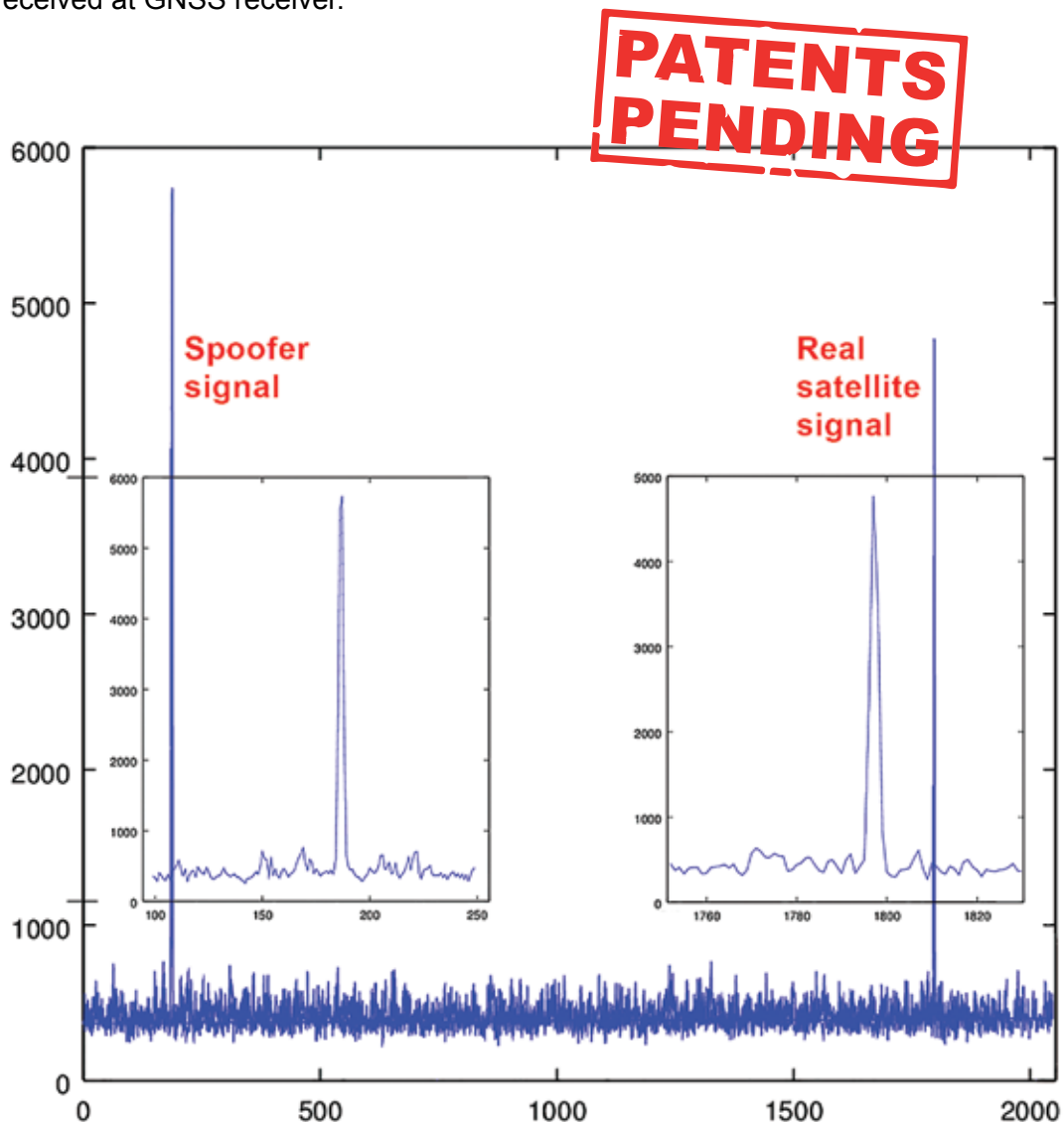
Spoofers Detection

With 864 channels and about 130,000 quick acquisition correlators in our TRIUMPH chip, we have resources to assign more than one channel to each satellite to find ALL signals that are transmitted with that GNSS satellite PRN code.

If we detect more than one reasonable and consistent correlation peak for any PRN code, we know that we are being spoofed and can identify the spoofed signals.

When we detect that spoofing is in effect, we use the position solution provided by all other clean signals (L1, L2, L5, etc... GPS, GLONASS, Galileo, Beidou, etc...) to identify the spoofer signal and use the real satellite measurement. If all GNSS signals are spoofed or jammed, then we alarm you to ignore GNSS and use other sensors in your integrated system.

Figure below shows an example of a spoofer signal and a real satellite signal received at GNSS receiver.



Satellite and Spoofer Peaks

The screenshots below are from a real spoofer in a large city. The bold numbers are for the detected peaks. The gray numbers represent highest noise, not a consistent peak. "*" symbol next to the CNT numbers indicate that signal is used in position calculation. Each CNT count represent about 5 seconds of continuous peak tracking.

SAT	EL	S	Range 1	Dopp	CNT 1	S	Range 2	Dopp	CNT 2	dRng	dDop	N
GPS5	33	16	61.14	1382	184*	4	25.95	181	1	29.32	1201	29
GPS7	51	21	14.39	1146	184*	4	18.21	-453	1	2.80	1599	29
GPS8	30	18	65.10	-918	184*	4	4.26	-1318	1	3.68	400	29
GPS9	12	14	40.46	2966	184*	4	2.08	3765	1	26.13	-799	29
GPS13	40	16	46.92	-3525	184*	4	8.21	-4325	1	25.80	800	29
GPS15	12	14	12.46	-4336	30*	5	33.00	-1536	1	19.52	-2800	28
GPS20	24	12	13.19	-1707	107*	4	29.32	-3307	1	15.11	1600	29
GPS27	16	11	10.26	1264	184*	4	43.55	63	1	31.22	1201	29
GPS28	53	19	9.41	-2724	184*	4	7.93	-4724	1	0.46	2000	29
GPS30	81	22	13.79	-332	184*	5	34.16	1266	1	19.35	-1598	28
GLN-4	54	20	62.08	1498	1158*	5	21.72	2697	1	24.16	-1199	25
GLN5	46	20	18.04	-2897	524*	4	26.26	-3697	1	7.20	800	25
GLN0	37	18	30.37	2355	1469*	4	38.37	1554	1	6.98	801	25
GLN-1	82	18	34.92	-776	189*	4	12.54	-1576	1	21.35	800	25
GLN-2	26	12	30.96	-4358	229*	4	11.80	-3158	1	18.13	-1200	25
GLN2	21	10	59.73	288	551*	4	47.55	1087	1	11.16	-799	25
GLN4	22	15	30.59	-3361	208*	4	11.74	-5361	1	17.83	2000	25
GLN-5	21	14	20.17	276	187+	3	25.45	2275	1	4.26	-1999	25

Esc Sat: 10 7 6 4 4 0 dPos: 19.0m Age: <1s

No spoofer. Only one reasonable peak for each satellite.

SAT	EL	S	Range 1	Dopp	CNT 1	S	Range 2	Dopp	CNT 2	dRng	dDop	N
GPS7	76	20	61.16	-170	172*	9	63.78	-170	120	1.60	0	29
GPS30	74	22	14.53	-1845	49*	7	6.01	-1845	19	7.50	0	30
GLN5	69	22	49.16	-1303	172*	5	65.16	-2103	1	14.98	800	25
GLN-1	61	20	55.62	1263	171*	4	58.55	-736	1	1.91	1999	25
GLN-2	54	18	24.13	-3275	171*	4	53.86	-5275	1	28.70	2000	25
GPS5	43	19	26.40	-583	48*	9	13.48	-583	24	11.90	0	29
GLN-4	40	20	61.05	2742	171*	4	45.79	4741	1	14.24	-1999	26
GPS9	36	20	59.25	2262	175*	9	53.37	2261	24	4.86	1	29
GPS28	27	14	9.12	-4021	171*	9	52.93	-4021	26	20.70	0	29
GPS8	22	13	9.82	-2924	24*	9	61.74	-2924	24	12.60	0	29
GPS27	22	14	29.92	-849	24*	8	53.07	-849	24	22.13	0	29
GLN6	21	18	38.59	-4785	172*	4	43.29	-5585	1	3.68	800	25
GPS13	18	13	14.51	-4321	55*	10	46.79	-4321	55	31.26	0	28
GLN4	18	16	3.58	-2586	172*	4	29.56	-986	1	24.96	-1600	25
GLN2	15	11	29.56	945	171*	3	46.00	-1454	1	15.42	2399	25
GLN-5	14	14	12.91	950	171+	4	22.15	3349	1	8.22	-2399	25
GPS20	12	12	6.61	-3548	10*	9	25.95	-3548	10	18.32	0	28
GLN0	12	15	61.49	3236	171*	4	60.09	4435	1	0.37	-1199	25

Esc Sat: 11 9 4 5 4 1 2 dPos: 17.8m Age: <1s

GPS GLN GAL BDU IRN QZ ◀ Number of satellites used in position calculation

In the above screenshot all GPS satellites have two peaks and all are spoofed. We were able to distinguish the spoofer signal and use the real satellite signals in correct position calculation as indicated by the "*" next to the CNT numbers.

GNSS Overall View

The screenshot below shows the status of all GNSS signals. The format and the signal definitions are explained below.

GPS	C/A 29	P1 28	P2 29	L2C 29	L5 28				
	10 1 9	10 0 0	10 3 0	6 6 0	4 0 0				N/A
	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0				
GLONASS	CA/L1 25	P1 26	P2 25	CA/L2 26	L3 25				
	10 8 0	10 0 0	9 0 0	9 1 0	1 0 0				N/A
	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0				
Galileo	E1 25	E5 25	E5B 24		E5A 25				
	5 4 0	5 0 0	5 0 0	N/A	5 0 0				N/A
	0 0 0	0 0 0	0 0 0		0 0 0				
BeiDou	B1-1 25	B1-2 26	B2 26		B5A 26	B1C 26			
	8 5 0	1 0 0	7 0 0	N/A	2 0 0	2 0 0			
	0 0 0	0 0 0	0 0 0		0 0 0	0 0 0			
IRNSS	N/A	N/A	N/A	N/A	L5 26				
					4 4 0				N/A
					0 0 0				
QZSS	C/A 26			L2C 25	L5 25	L1C 26			
	1 1 0	N/A	N/A	1 0 0	1 0 0	1 0 0			
	0 0 0			0 0 0	0 0 0	0 0 0			

GPS L2C: L+M
 GLN L3: I+Q
 GAL E1: B+C
 GAL E5: albc
 GAL E5B: I+Q
 GAL E5A: I+Q
 BeiDou B2: B5B
 QZSS L2C: L+M
 QZSS L1C: I+Q

Esc
 Number formats

tracked	used	spoofed
blocked	faked	replaced

Average noise level

Definitions for the number of signals:

Tracked: Tracked by the tracking channels and has one valid peak only.

Used: Used in position calculation.

Spoofed: Has two peaks. Good peak is isolated, if existed.

Blocked: Blocked by buildings or by jamming. If jammed, shows higher noise level.

Faked: Satellite should not be visible, or such PRN does not exist.

Replaced: Real signal is jammed and a spoofed signal put on top of it. Because of jammer, it shows higher noise level.

Spoofers detection available in all of our OEM boards too.

See details in GPS World expert opinions section "What is the biggest challenge facing designers of multi-constellation GNSS receivers today?" with Javad Ashjaee and at www.javad.com

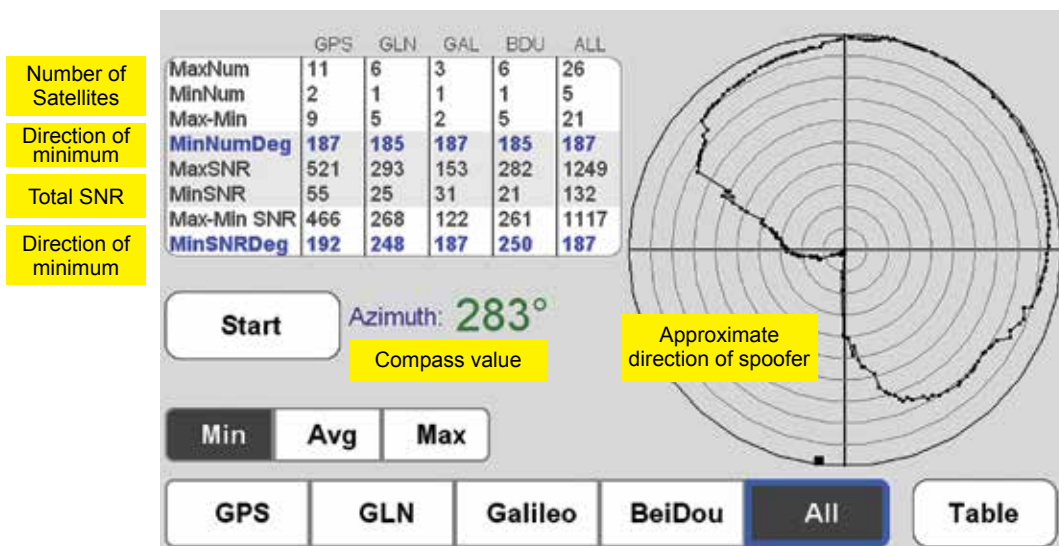


Spoofing Orientation

When you detect that spoofers exist, you can also try to find the direction that the spoofing signals are coming from. For this, hold your receiver antenna (e.g. TRIUMPH-LS) horizontally and rotate it slowly (one rotation about 30 seconds) as shown in the picture and find the direction that the satellite energies become minimum. This is the orientation that the spoofer is behind the null point of the antenna reception pattern.



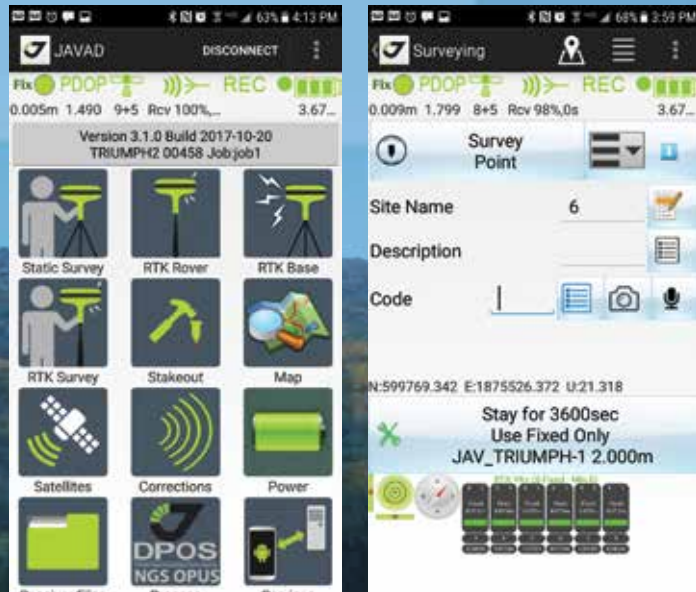
After one or more full rotations observe the resulting graph that shows approximate orientation of the spoofer as shown in figure below.



This screenshot is from the experiment within an anechoic chamber. That is why the picture is clean and smooth.

Javad Mobile Tools (JMT)

I used "Beast Mode" on a small project yesterday and all I can say is WOW!!!! Did Javad and Red Bull team up to enhance RTK or did my system drink hypercaffeinated coffee when I wasn't looking? Amazing accomplishment/development Javad. I can't imagine using any other GPS equipment.



"I surveyed 20 acres today and never used the total station."

Javad Mobile Tools (JMT) is an RTK & static control software app which allows you to connect JAVAD GNSS receivers to Android or iOS devices. JMT includes a full set of RTK and static survey routines including, data collection (RTK and static), RTK stakeout, CoGo, localization and more.

"Since I got the Javad system, I go places NEVER BEFORE possible, and WITH confidence, because, the quality checks are there."

"The only bitching now is for the crew that has to take out the Hyper V."

"Using licensed professionals for development has been a brilliant idea. Tip of the hat to the programmers and designers that put the original box together it appears to me that they knew where they were going with this years ago."

