



Uživatelské testování spolehlivosti GPR

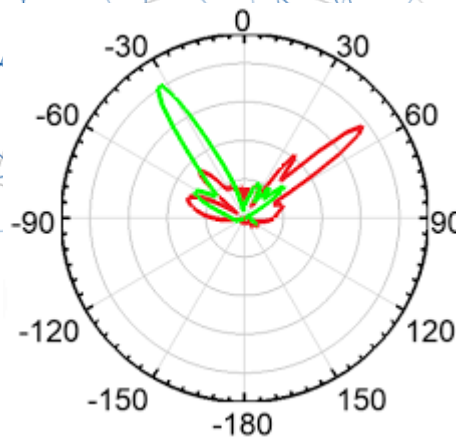
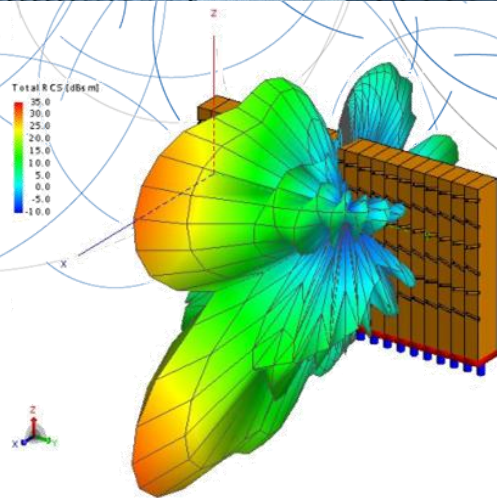
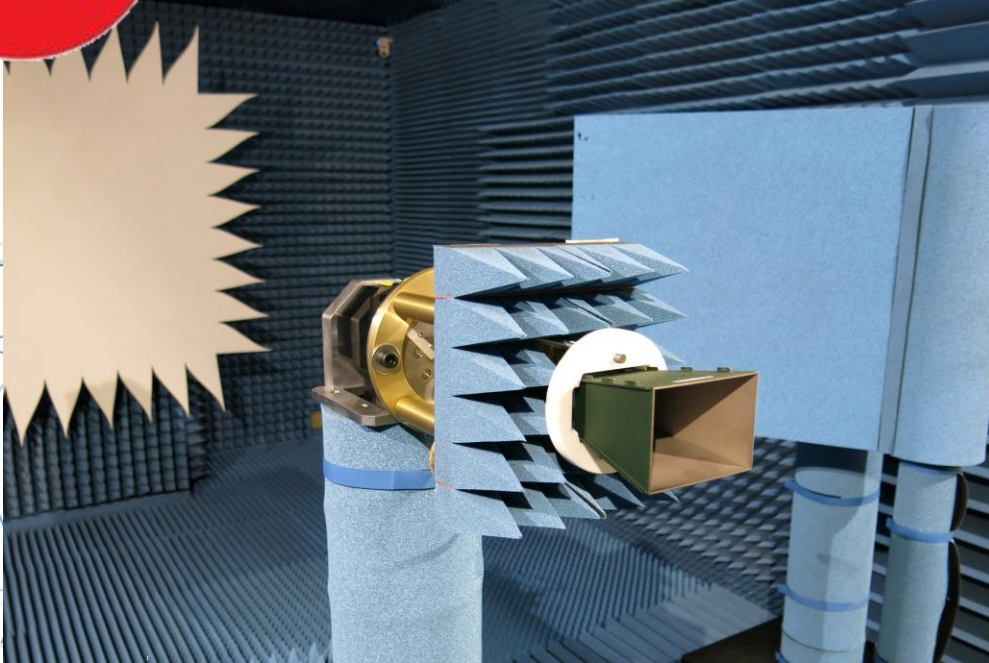
Jak (jako běžný uživatel) ověřit výkonnost a spolehlivost GPR zařízení?



GPR System Performance Compliance According to Cost Action TU1208 Guidelines

- Dosavadní postupy a metody (včetně ASTM D6087)
- Metodika COST
- Testování a analýza výsledků na základě metodiky COST TU1208
- FACULTY OF TECHNICAL SCIENCES, **UNIVERSITY OF NOVI SAD**, NOVI SAD
- **BELGIAN ROAD RESEARCH CENTRE (BRRC)**, BRUSSELS, BELGIUM
- **INSTITUT FRANÇAIS DES SCIENCES ET TECHNOLOGIES DES TRANSPORTS, DE L'AMÉNAGEMENT ET DES RÉSEAUX (IFSTTAR)**, NANTES, FRANCE
- **UNIVERSITY OF PARDUBICE, PARDUBICE, CZECH REPUBLIC**
- **ANADOLU UNIVERSITY**, TURKEY
- **NATIONAL LABORATORY OF CIVIL ENGINEERING (LNEC)**, LISBON,
- EARTH AND LIFE INSTITUTE, **UNIVERSITÉ CATHOLIQUE DE LOUVAIN**, LOUVAIN-LA-NEUVE, BELGIUM
- DEPARTMENT OF INFORMATION ENGINEERING, ELECTRONICS AND TELECOMMUNICATIONS, **SAPIENZA UNIVERSITY OF ROME**





- **Signal-to-Noise Ratio Test (SNR Test)**
- **Signal Stability Test (SST)**
- **Linearity in the Time Axis Test (LIT)**
- **Long-Term Signal Stability Test (LTST)**

$$L = D + 2\sqrt{5\lambda_c}$$

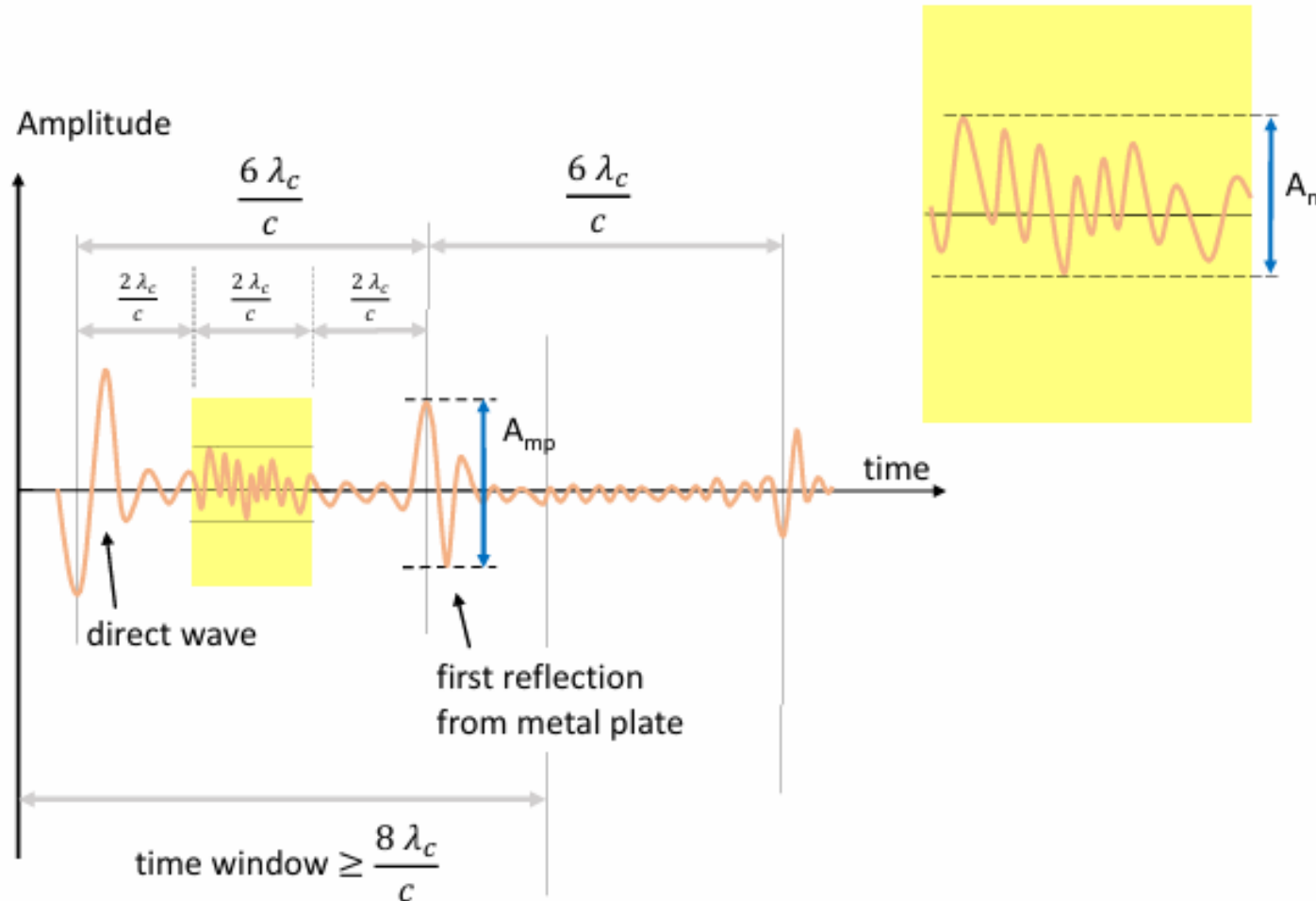
$$h_1 = 2\lambda_c, h_2 = 3\lambda_c, \text{ and } h_3 = 2.5\lambda_c$$

$$(TW > 8\lambda_c/c)$$

Limitní hodnoty	MIN	MAX	MAX	MAX
TEST	SNR	SST	LIT	LTST
COST TU1208 manuál	10	8.00%	6.5%	2.50%

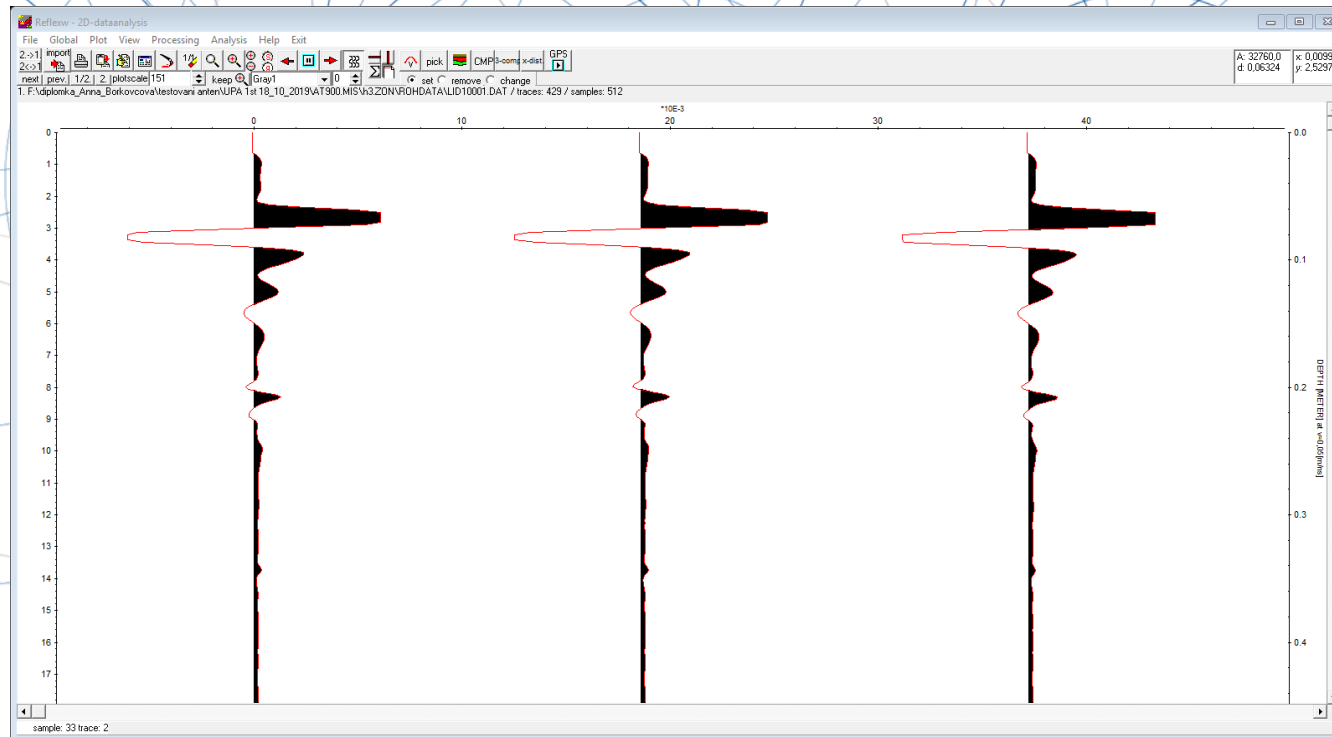
■ Signal-to-Noise Ratio Test (SNR) Test

Antenna offset	Number of traces	Data acquisition rate
h_1, h_2	100	N/A



$$I_{SNR} = \frac{\langle A_{mp} \rangle}{\langle A_n \rangle}$$

Antenna offset	Number of traces	Data acquisition rate
h_1	100	max.

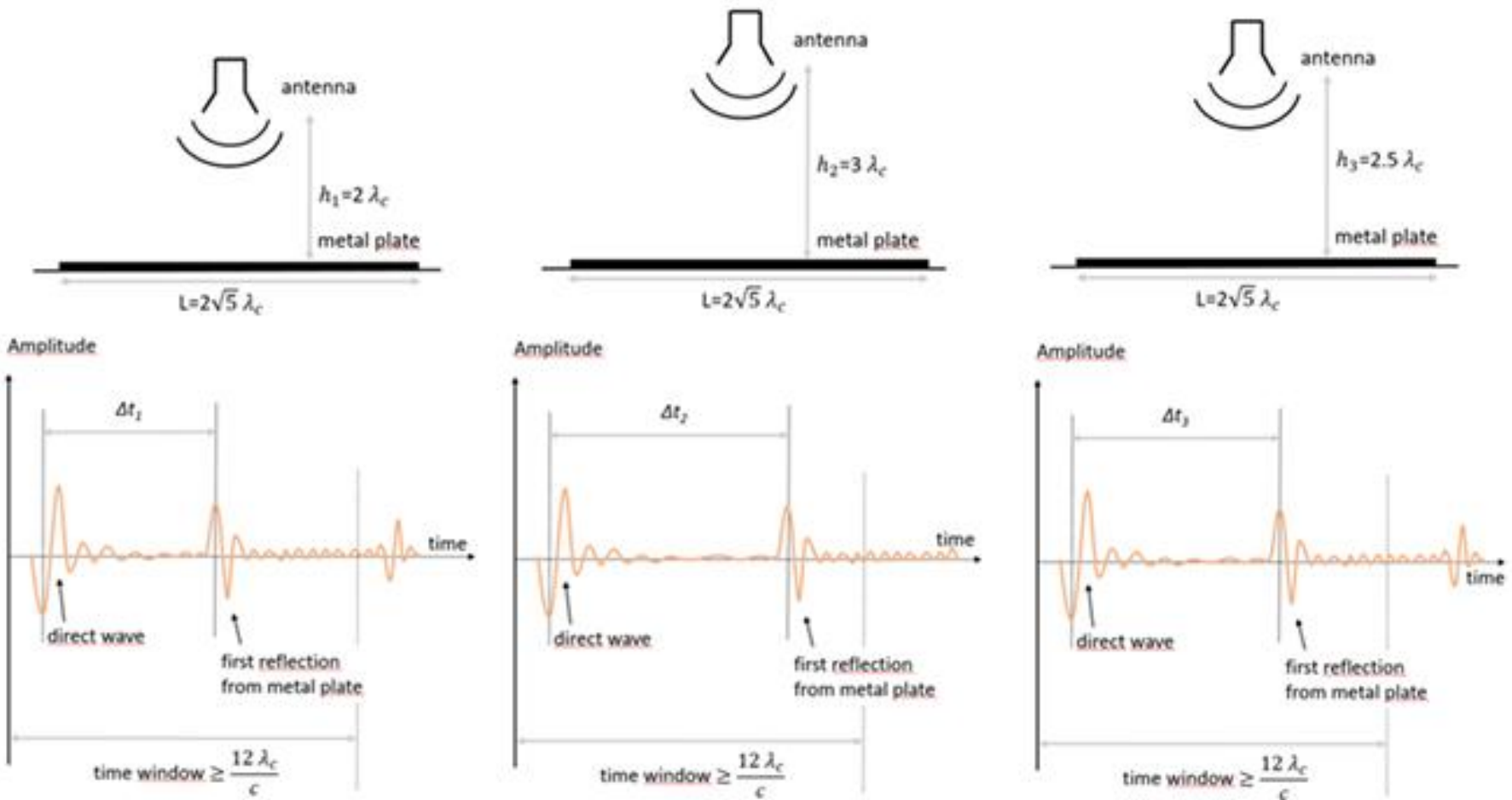


$$I_{Stability} = (A_{MAX} - A_{min})/A_{avg}$$

■ Linearity in the Time Axis Test (LIT)

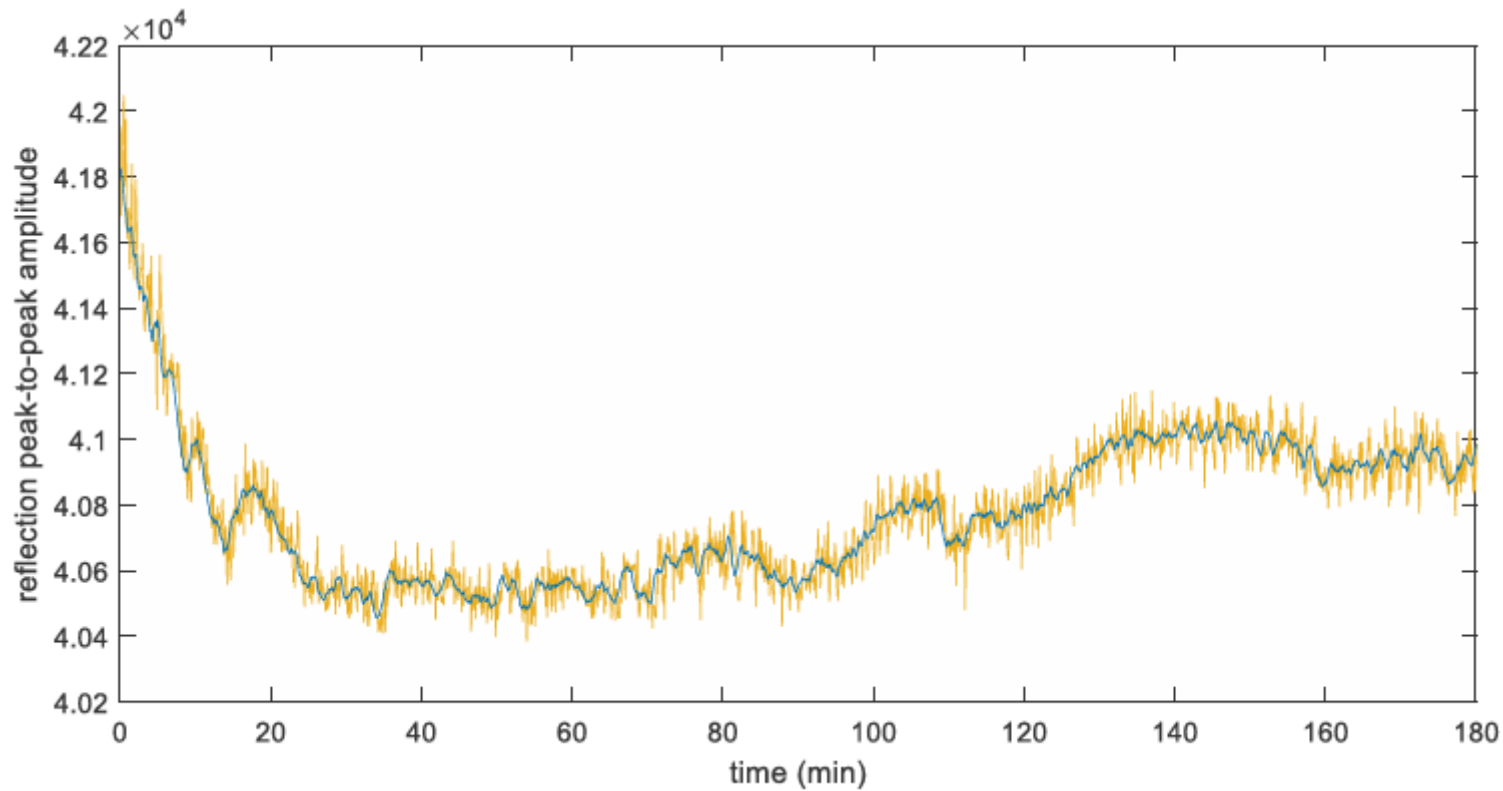
Antenna offset	Number of traces	Data acquisition rate
h_1, h_2, h_3	3*1	N/A

$T_{21}=|\Delta t_2 - \Delta t_1|$; $T_{31}=|\Delta t_3 - \Delta t_1|$



Long-Term Signal Stability Test (LTST)

Antenna offset	Number of traces	Data acquisition rate
h_1	1200	10 traces/min



$$M_q = \frac{1}{N} \sum_{j=0}^{N-1} A_{q+j}$$

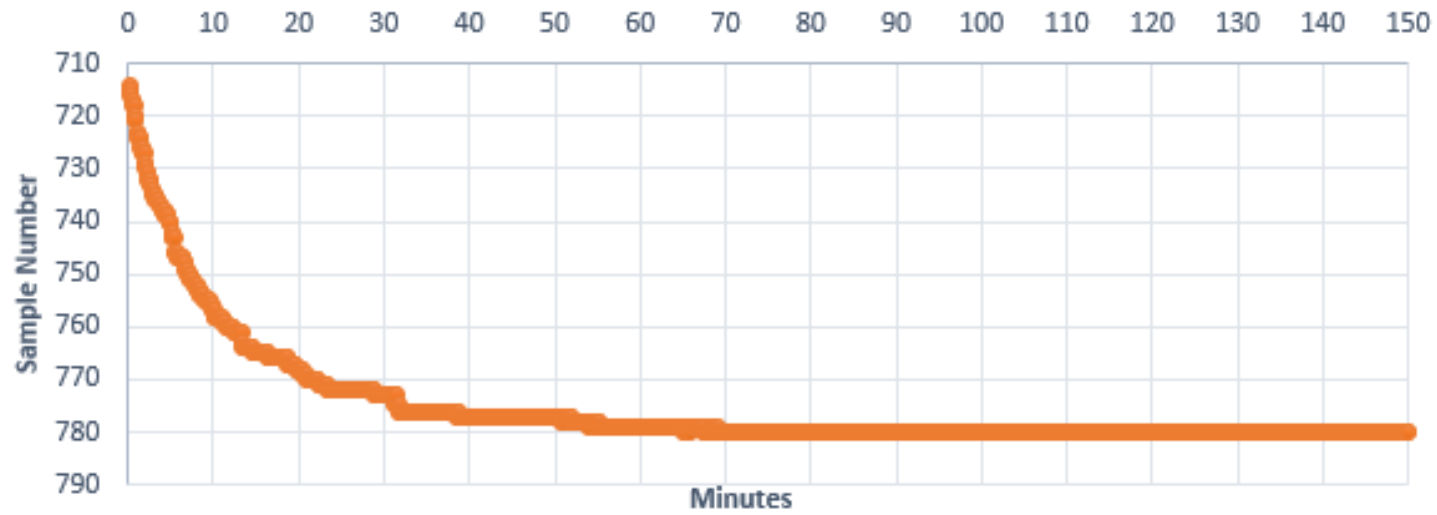
Dlouhodobé testování na DFJP

- Signal to Noise Ratio Test – SNR
- Signal Stability Test – SST
- Linearity in the Time Axis Test – LIT
- Long Term Stability Test – LTST
 - Posun na časové ose během LTST
 - Změna amplitud odrazu během LTST
- Změna frekvenčního spektra
- Posouzení délky warm-up period (WUP)

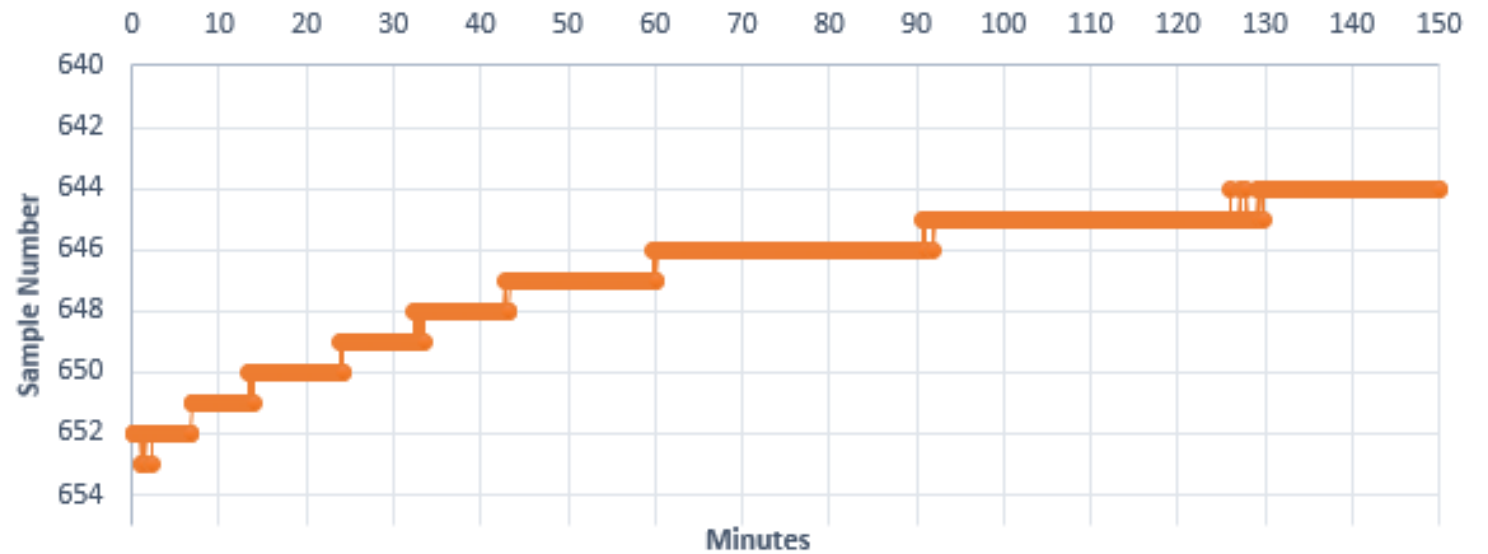
WUP+LTST (h1, min.1500, 10s/minuta)...5+30+120 minut
 h2 (min. 100, MAX)
 h3 (min. 100, MAX)

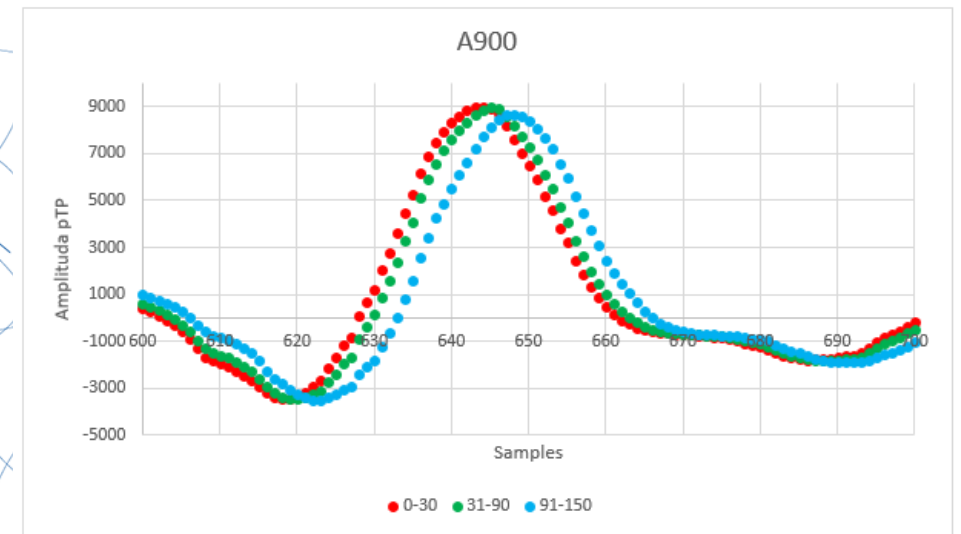
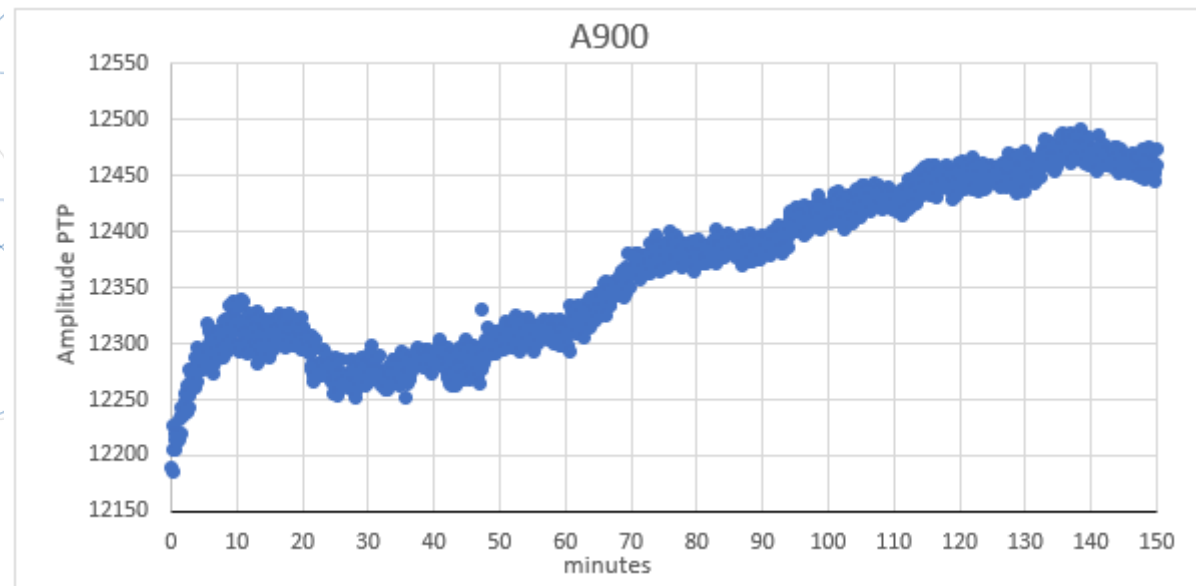
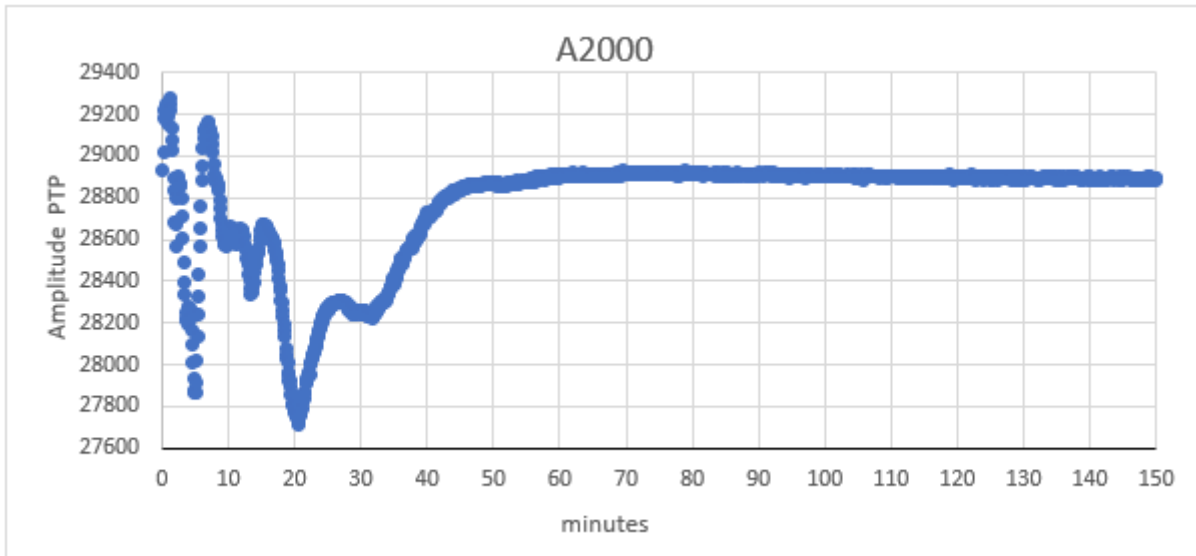
Datum testování	Označení antény	Uvedení do provozu	Doba provozu (h)
2018_01	A2000	2013	200
	A900	2013	200
	A400	2013	200
2018_08	A2000	2013	200
	A900	2013	200
	A400	2013	200
2018_11	B2000	2018	5
	B1000	2013	10
	B400_1724	2016	567
	B400_1725	2016	567
2019_10	A2000	2013	250
	A900	2013	250
	A400	2013	250
2020_07	B2000	2018	10
	B1000	2013	15
	B400_1724	2016	850
	B400_1725	2016	850
2020_12	A2000	2013	300
	A900	2013	300
	A400	2013	300
2021_12	A2000	2013	350
	A900	2013	350
	A400	2013	350
2022_04	A900_FRHA	2019	30
2023_06	B2000	2018	15
	B1000	2013	65
	B400_1724	2016	1323
	B400_1725	2016	1323
2023_06	A2000	2013	400
	A900	2013	400
	A600	2022	10
	A400	2013	400

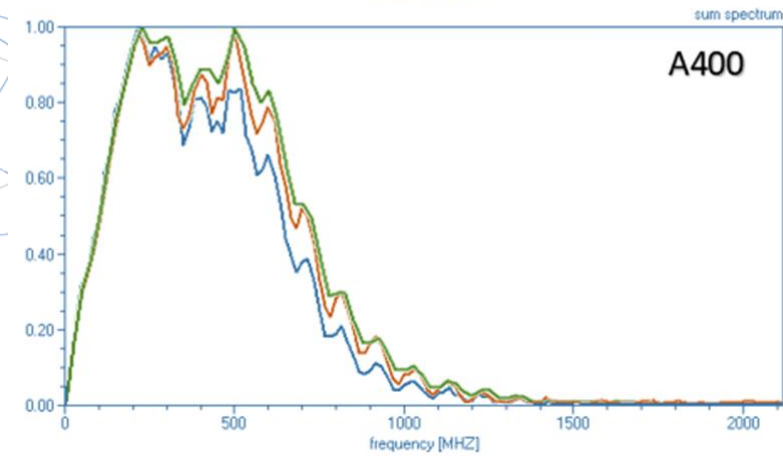
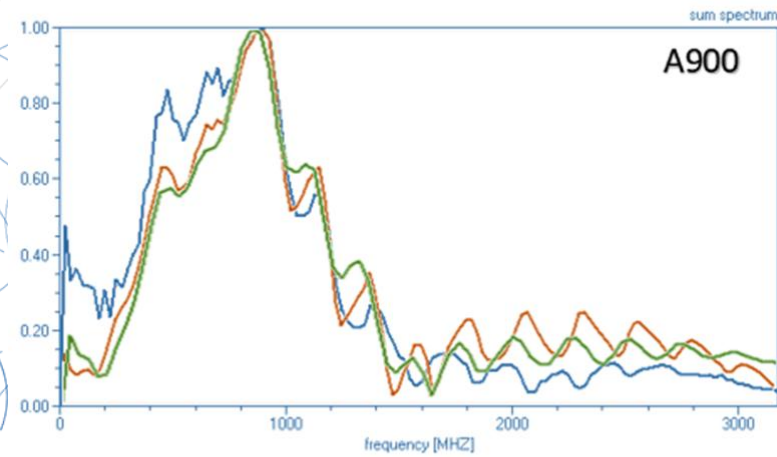
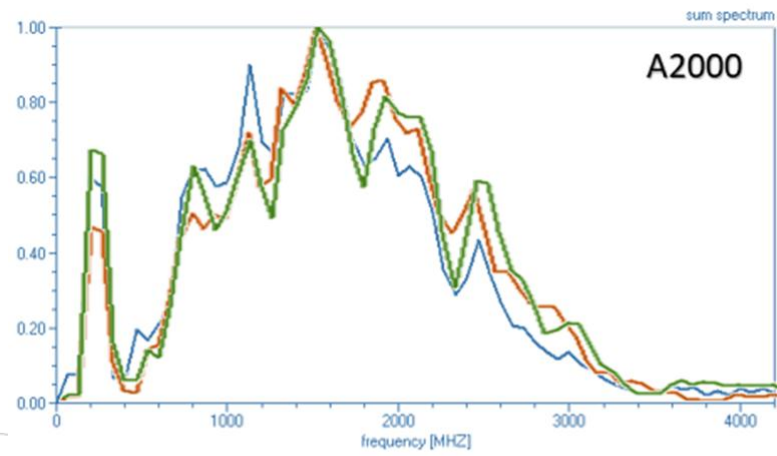
A2000



A900







Co povede ke zvýšení spolehlivosti prováděné diagnostiky?

- **Teorie, Normy**

Zpřesnění požadovaných postupů a formy výstupu (např. v TP 233 apod.)

- **Ověření spolehlivosti a výkonnosti**

Pravidelné uživatelské testování (např. dle COST)

- **Vzájemné porovnání**

Zahrnutí testování např. do Experimentu přesnosti dle TP 207



Děkuji za pozornost.