Research project ROSI-3D

“Analysis of the Radio Propagation Model at RFID Applications”

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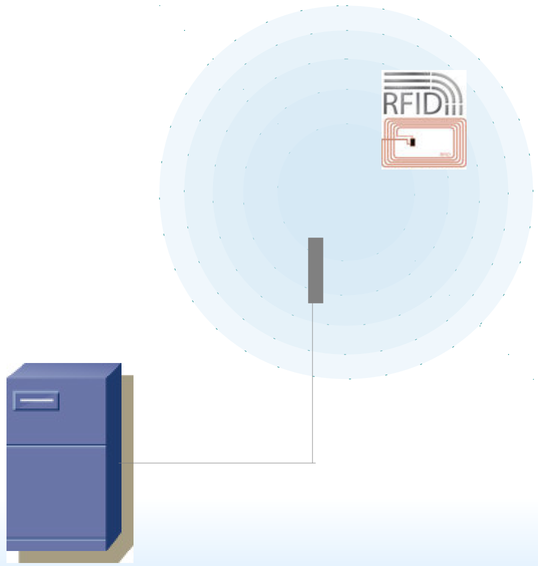
The challenge of localisation

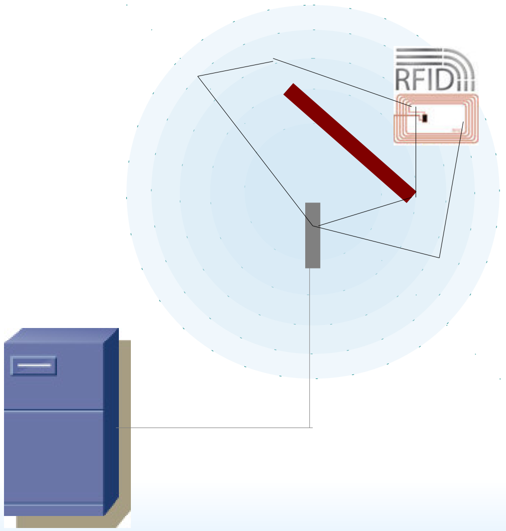
- Radio propagation well known for free space and far-field situation
- Real RFID -systems take place with
  - multipath propagation,
  - disturbing objects in the transmission path,
  - near field ingress
  - dynamic changing situations
- In cases of mobile disturbing objects no models available

Localisation situation

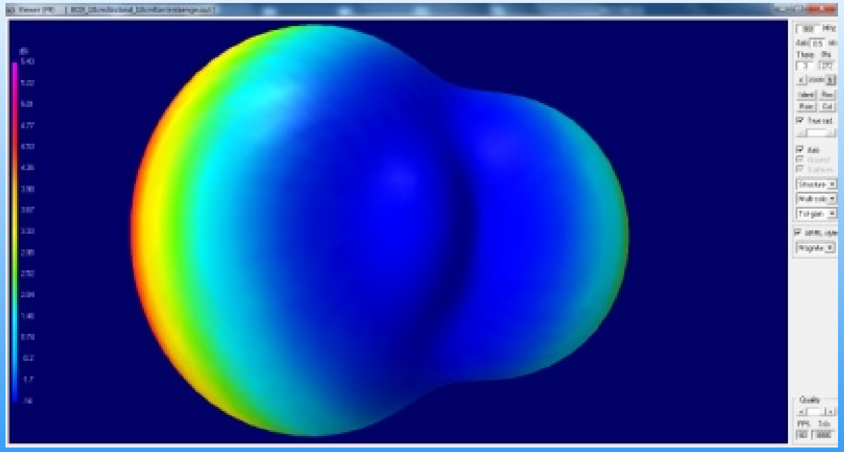
Ideal situation



real situation



cm< x <... m

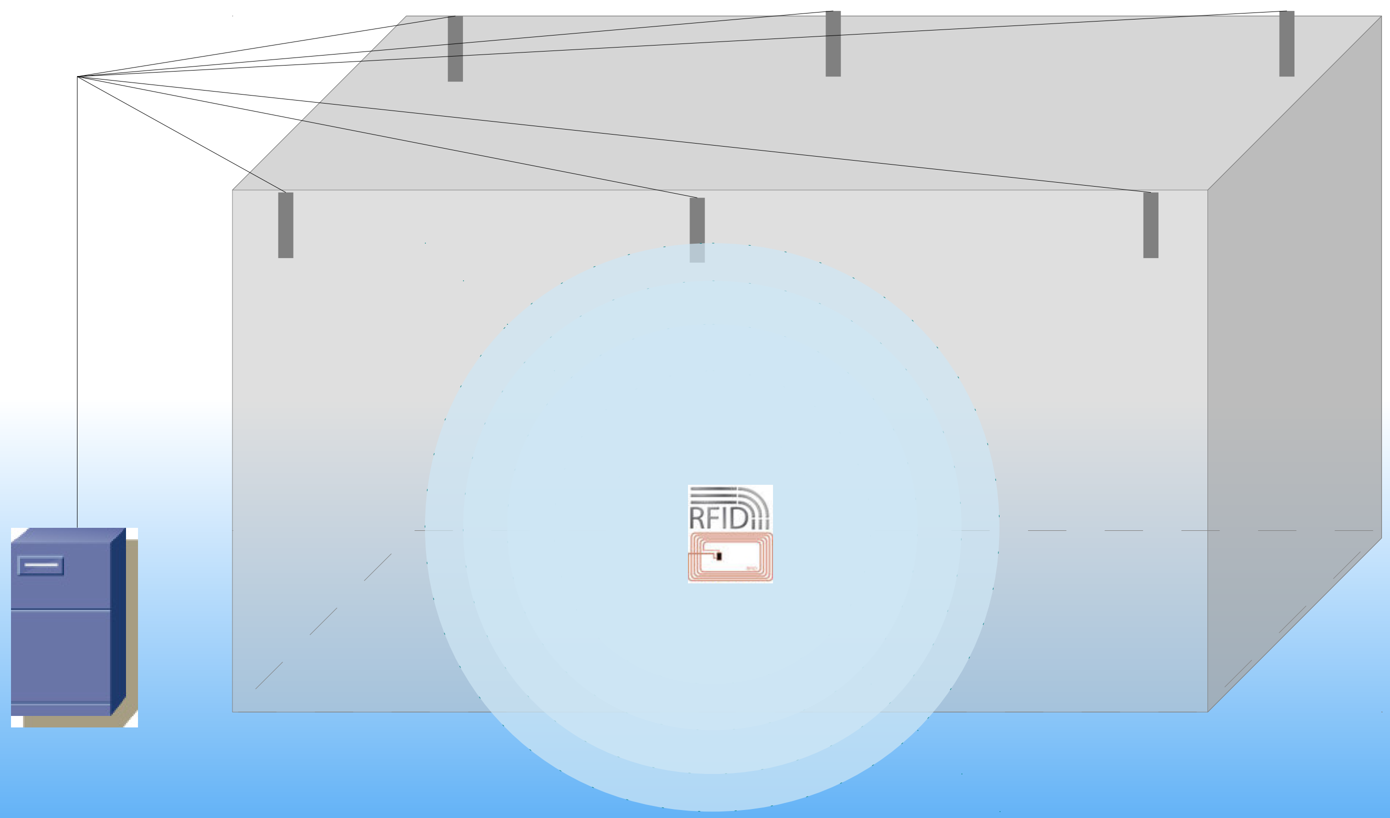


Field
disturbing object

Localization principles

- RSSI
  - Easy to use, but sensitive by ingress
- Angle off arrival (AoA)
  - High accuracy, high requirements
- Time of Arrival (ToA)
  - requirements of synchronisation
- Phase of arrival (PoA)
  - In case of multipath situation
- Combining methods

Trouble shoot disturbing objects



But how to resolve, if tag, reader and disturbing object in one layer ?

Requirement specifications

- Working for frees pace and multipath situations
- Include situations with disturbing objects
- Possibility simulate propagation of real environments
- Approximate in case of mobile disturbing objects

The steps

- Analysing simple model and the approximation methods
- Model with disturbing objects
- Model with mobile disturbing objects
- Simulations
- Verify simulations in real environments

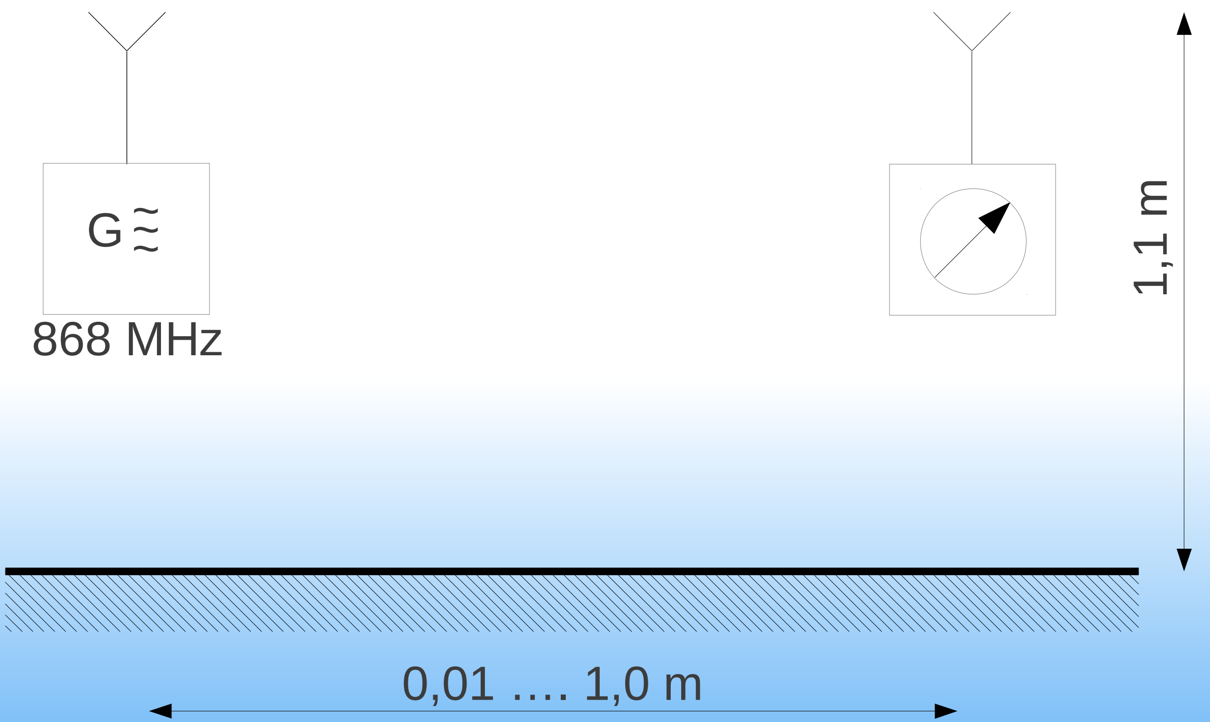
Can we find approximation ?

Easy model: linear propagation

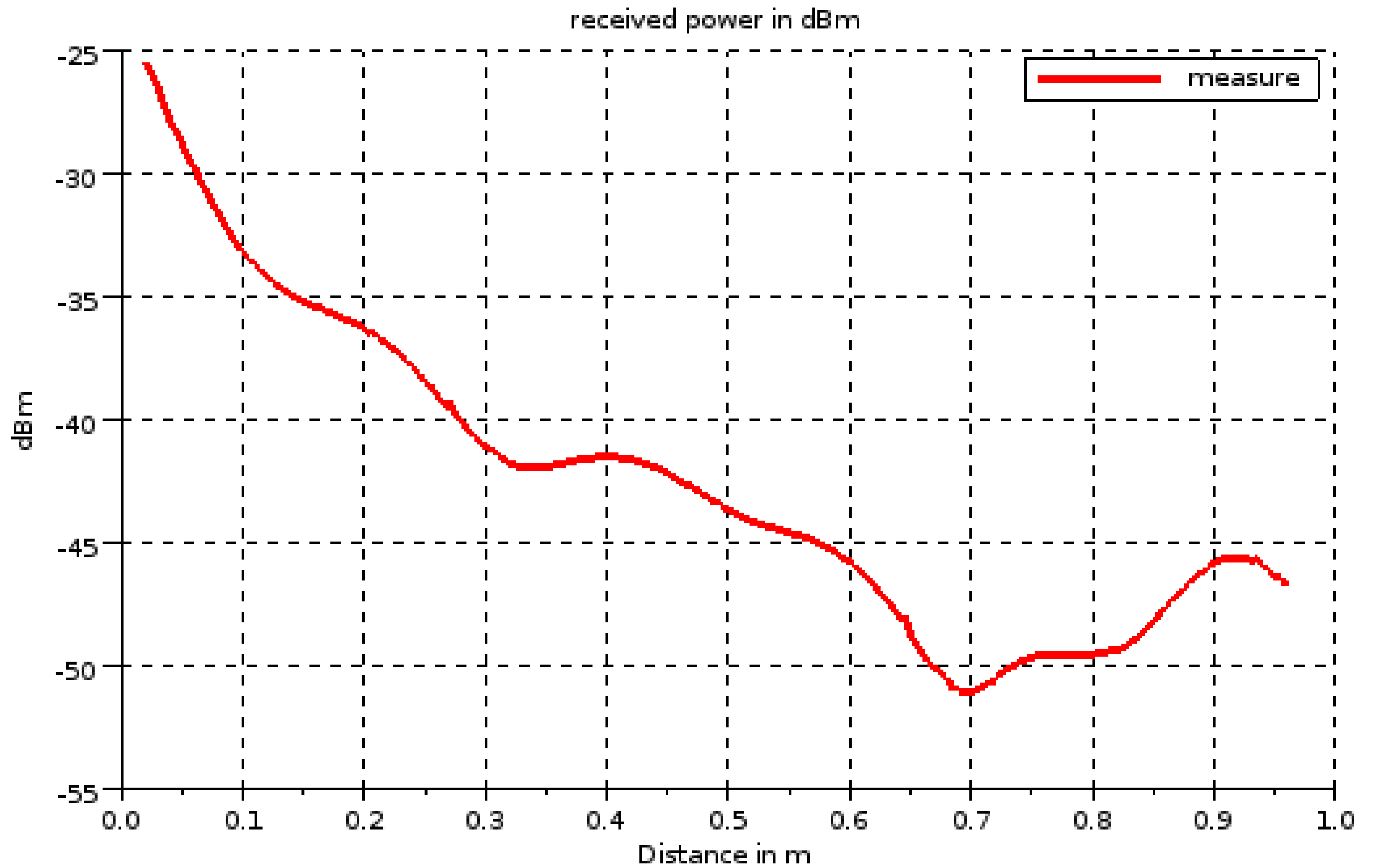
- Provide measurements
- Approximate results
- Compare approximation vs. measurements

The model and measurements

Analysing transmission path on 868 Hz



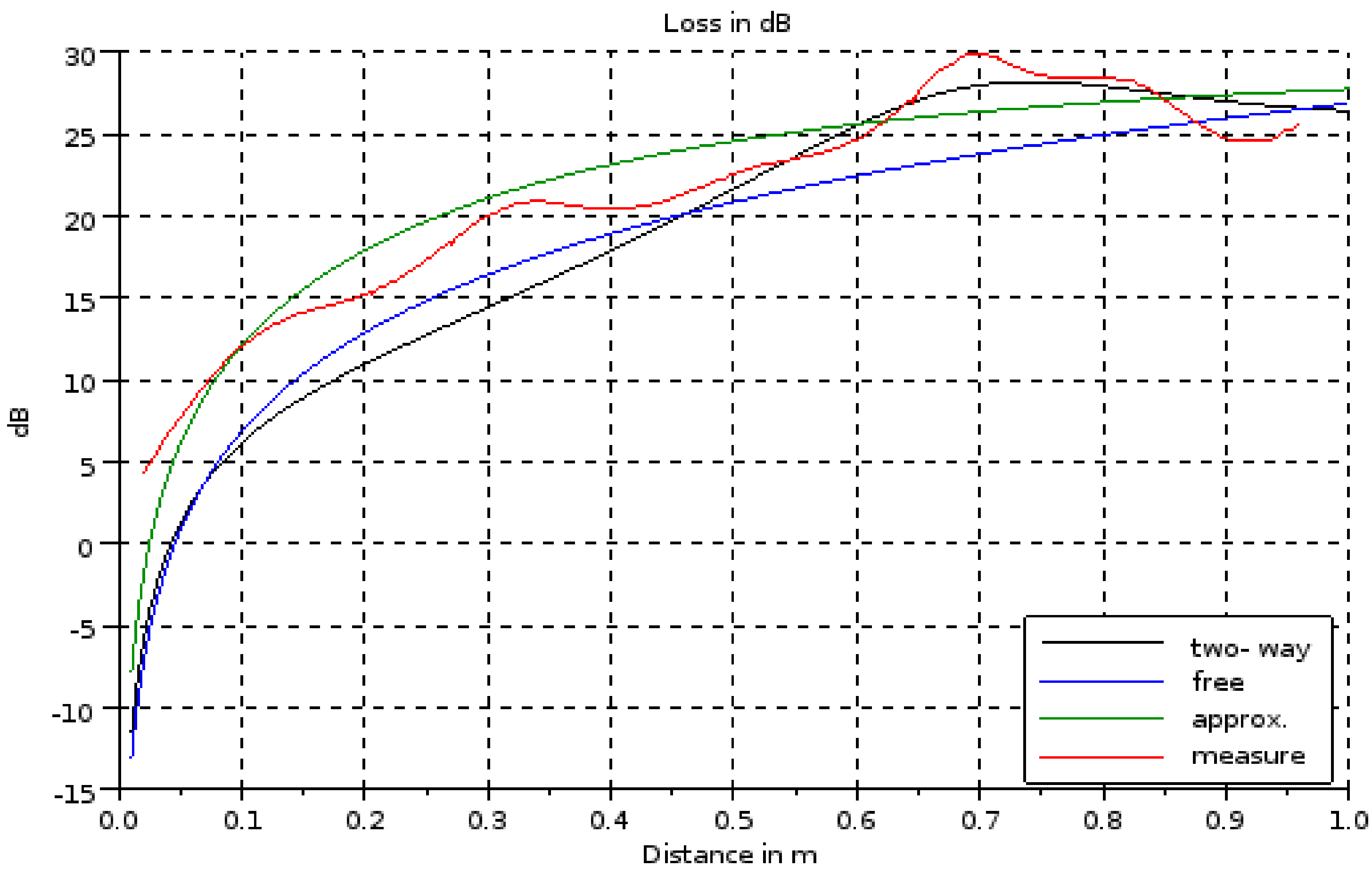
Measurement results



Approximation

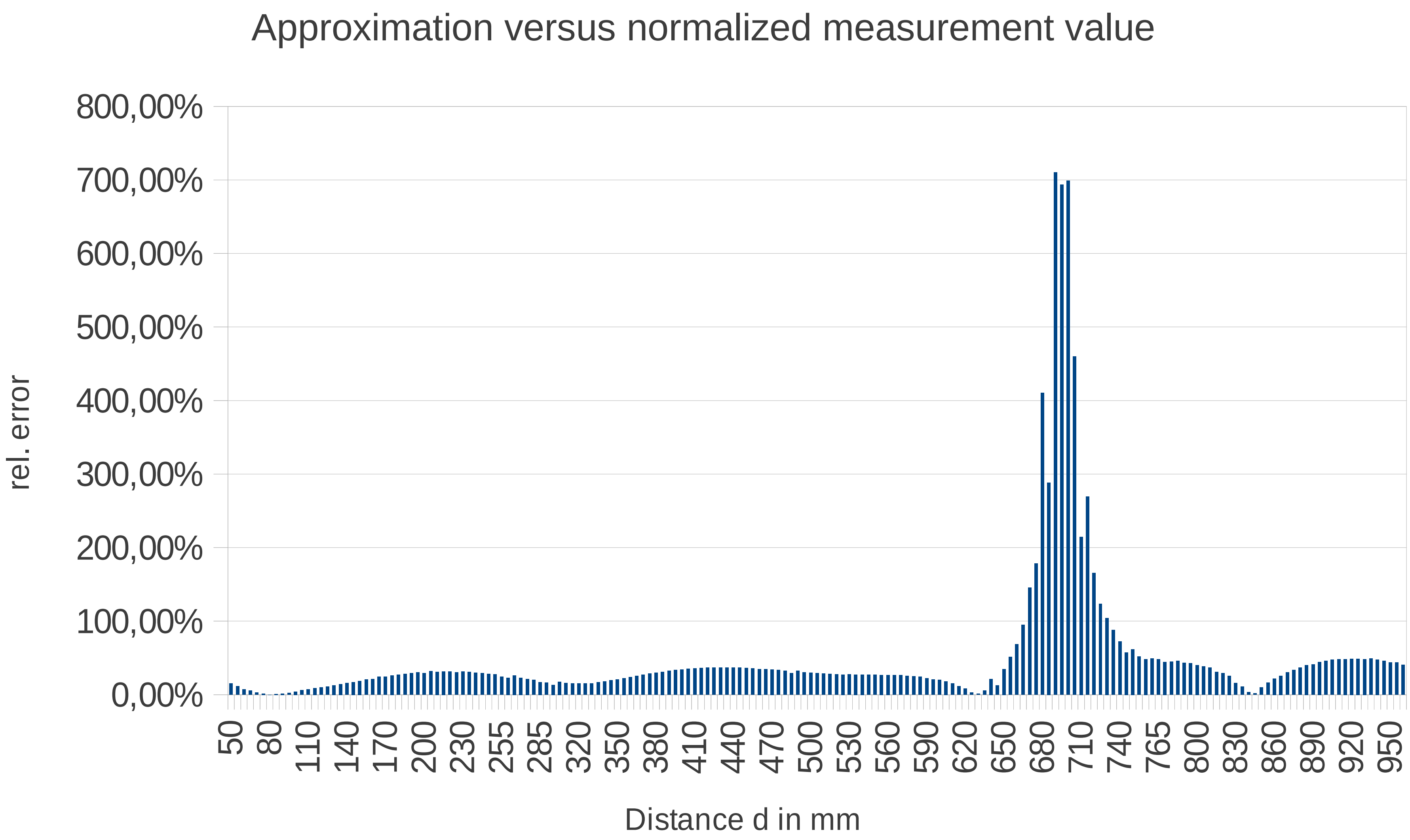
- approach of minimum square errors
  - $y=b*(a_0+a_1*x^{-1}+a_2*x^{-2})$
- Search values for b, a0, a1, a2 to minimize the error between approximated and measured values
- In our case:
  - $B=5*10^{-9}$
  - $a_0=1561{,}368$
  - $a_1=10^{-8}$
  - $a_2=877{,}22$

The results



Loss in dB
dB
Distance in m
30
25
20
15
10
5
0
-5
-10
-15
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
two- way
free
approx.
measure

Related error



Next steps

- Measurements with 4 antennas
- Measurements with disturbing objects
- Combining RSSI and AoA or other methods
- Simulations