

OTA Radar Stimulation for Vehicle Tests

M. Gadringer¹, M. Vorderderfler¹, H. Schreiber¹,
S. Metzner², W. Bösch¹

¹ Institute of Microwave and Photonics Engineering,
Graz University of Technology

² AVL List GmbH, Graz

michael.gadringer@tugraz.at

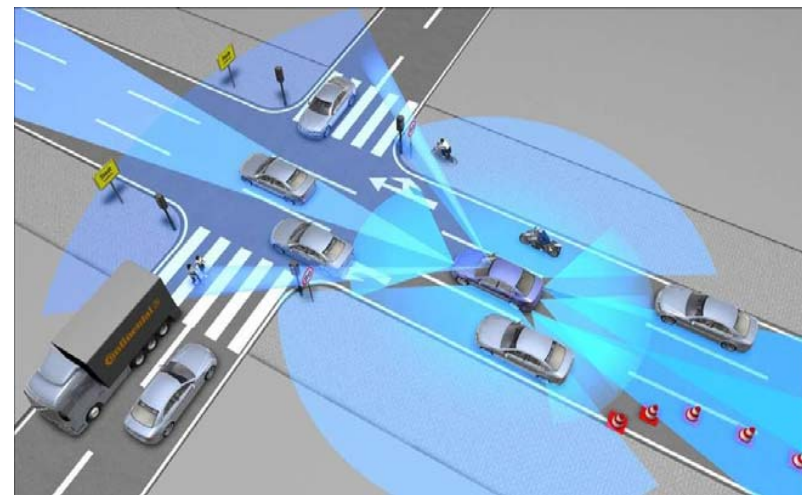
5. April 2019

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Why Radar Target Stimulation

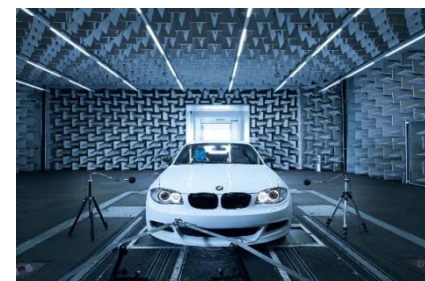
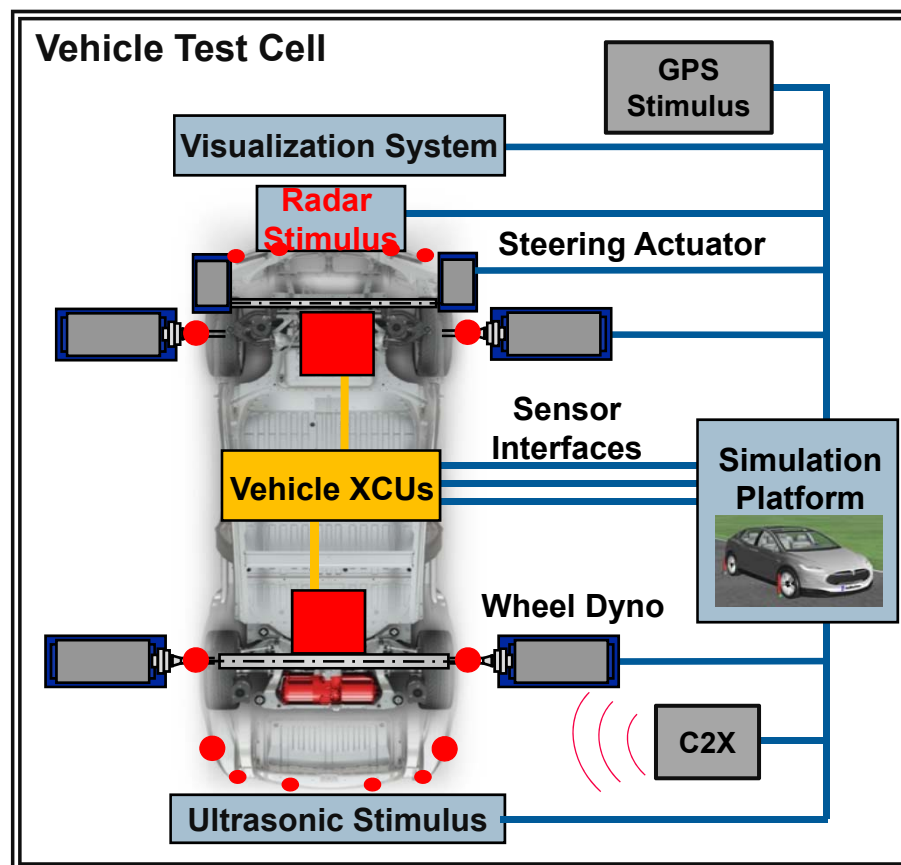
- Increasing functionality of Automatic Driving Assistance Systems (ADAS) depend on radar sensors
- Supports early adoption of Autonomous Driving (AD)
- Reliability during interference needs to be studied
- Verification of ADAS and AD in complex scenarios
- Millions of real world test kilometers are not affordable



from: <http://articles.sae.org/10794/>

Vehicle Stimulation

- Torque
- Ultrasonic sensors
- Steering actuator
- Camera
- Car2X
- GPS
- Radar sensor
- LiDAR

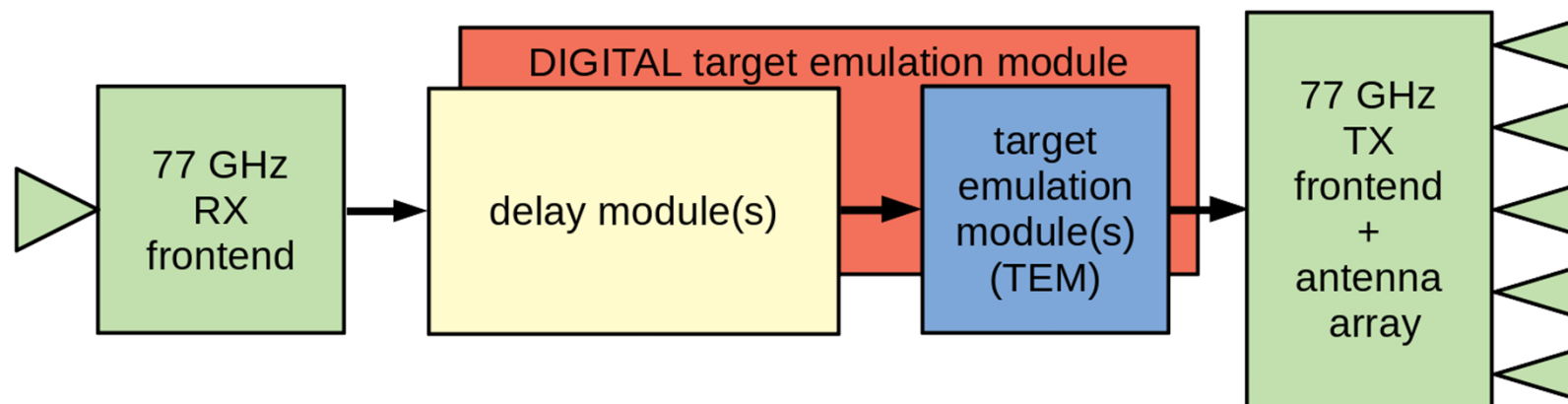


The Challenge

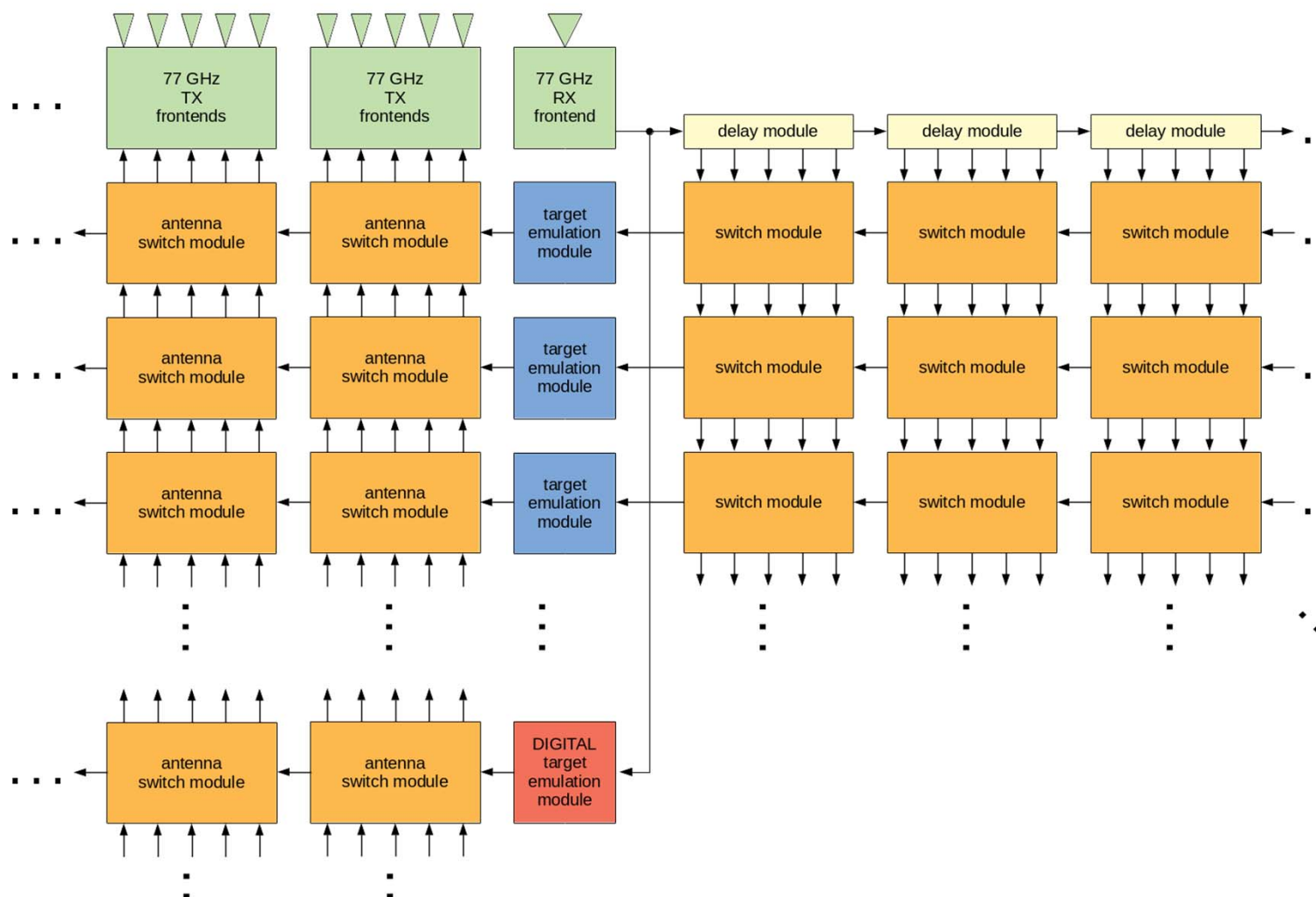
- Radar stimulation has to be coherent
⇒ It has to modify the transmitted signal to create a echo similar to the real target's.
- Over-the-Air (OTA) stimulation
- Radar is „unknown“: stimulation should work with as little a-priori knowledge about the radar as possible
- Short distance (starting from 2 meters)
- Complex scenarios with many targets (≥ 4)

Basic Concept

- Processing at intermediate frequency (2 GHz)
- Modular design
- Scalability
- Addition of interference signals possible



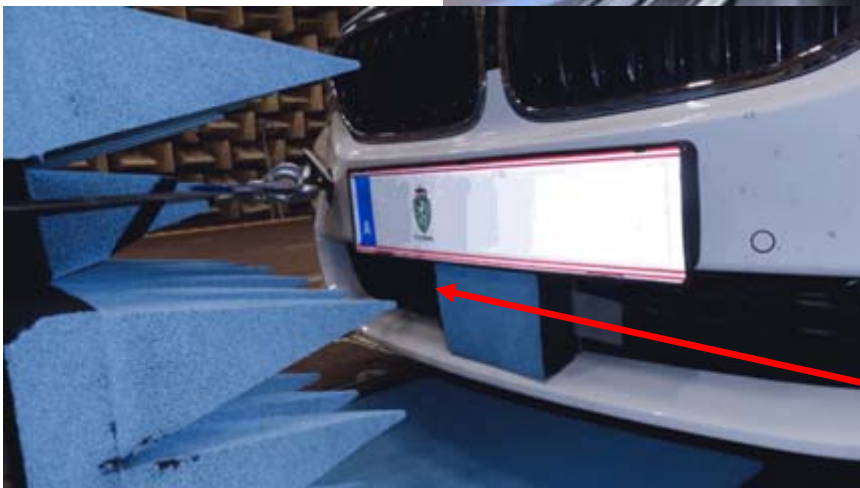
Overall Concept



Demo On a Dyno Testbed

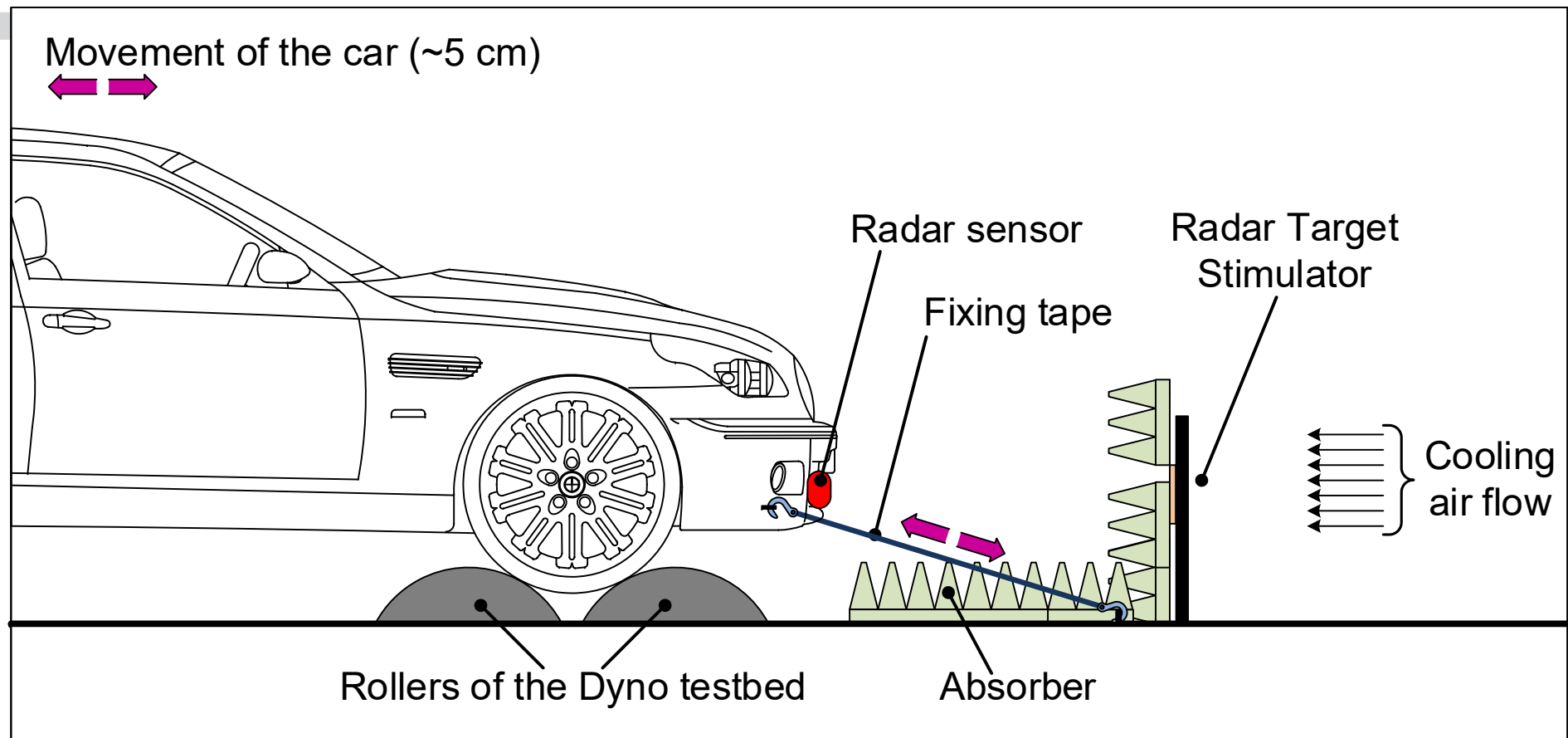


What Did We Avoid To Tell You?



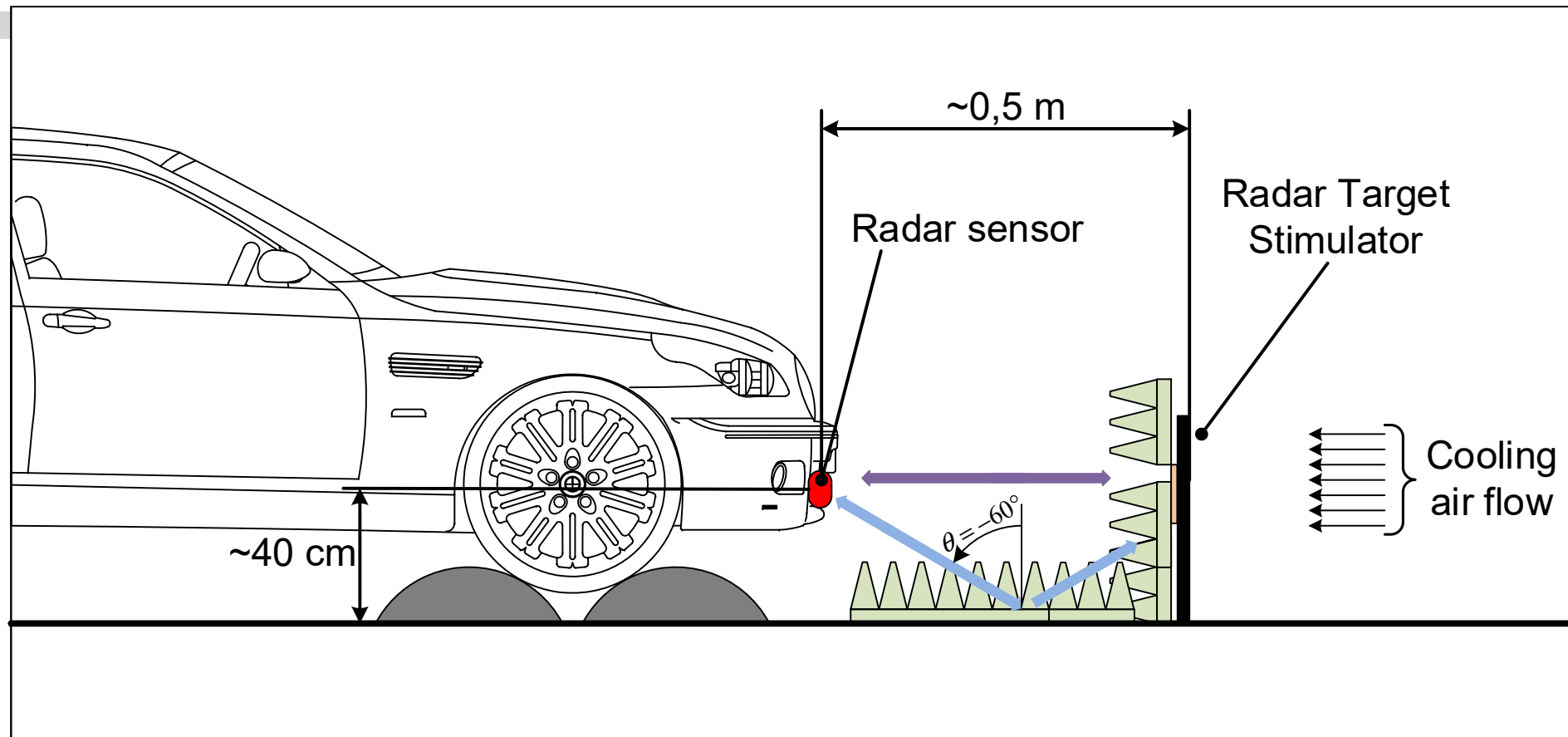
BMW mounted on a Dyno testbed
Radar Target Stimulator (RTS) mounted in front of the sensor

Car On a Dyno Testbed



Car On a Dyno Testbed

Radar Wave Propagation



Car On a Dyno Testbed Sensor Test Requirements

Testbed environment:

- Industrial environment
- Many metallic surfaces

Absorber specification:

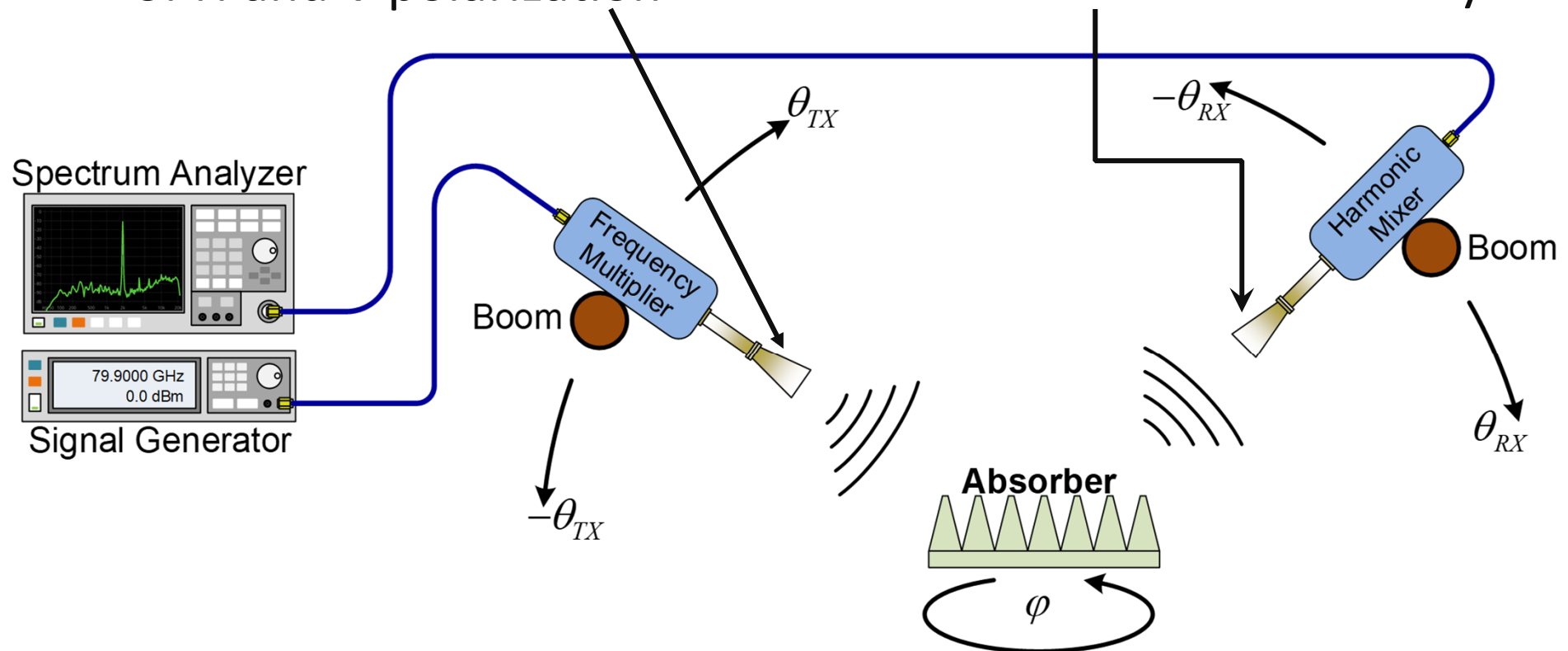
- Lower reflected signal magnitude
(compared to free space propagation)
- Avoid restrictions to cooling air flow
- Tolerant against movement of the vehicle / fixing tapes

⇒ **Precise knowledge on the absorber behavior required**

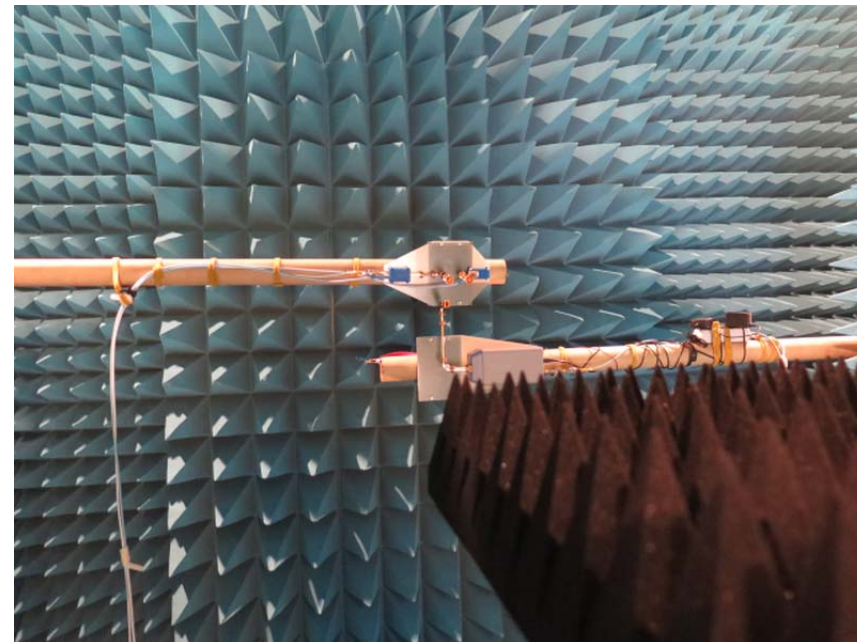
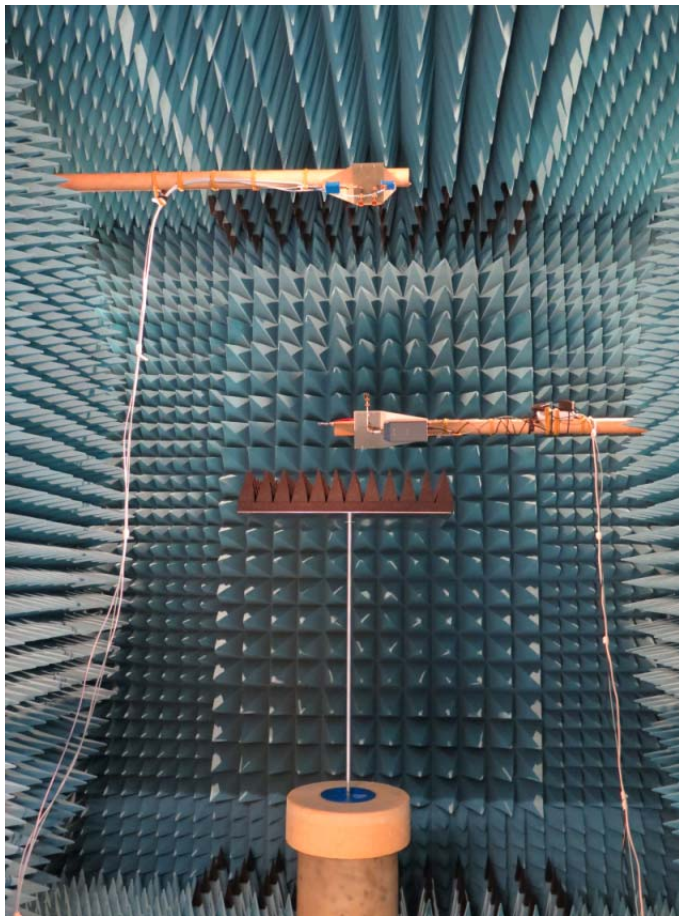
Absorber Characterization Measurement Setup

Consecutive measurement of H and V polarization

Both polarizations are recorded simultaneously

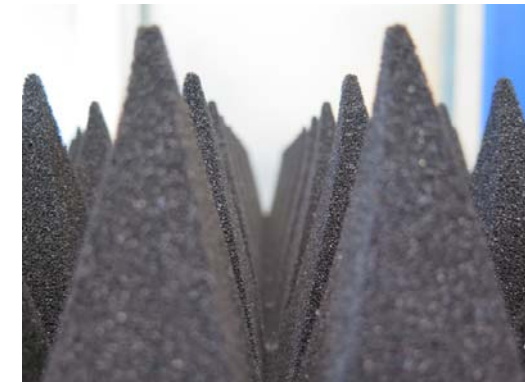
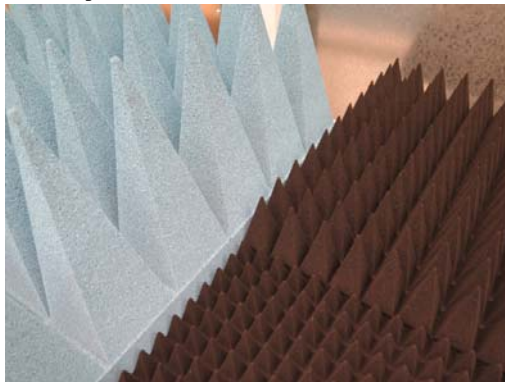


Absorber Characterization Measurement Setup



Absorber Characterization Considered Absorber

Pyramidal absorbers:

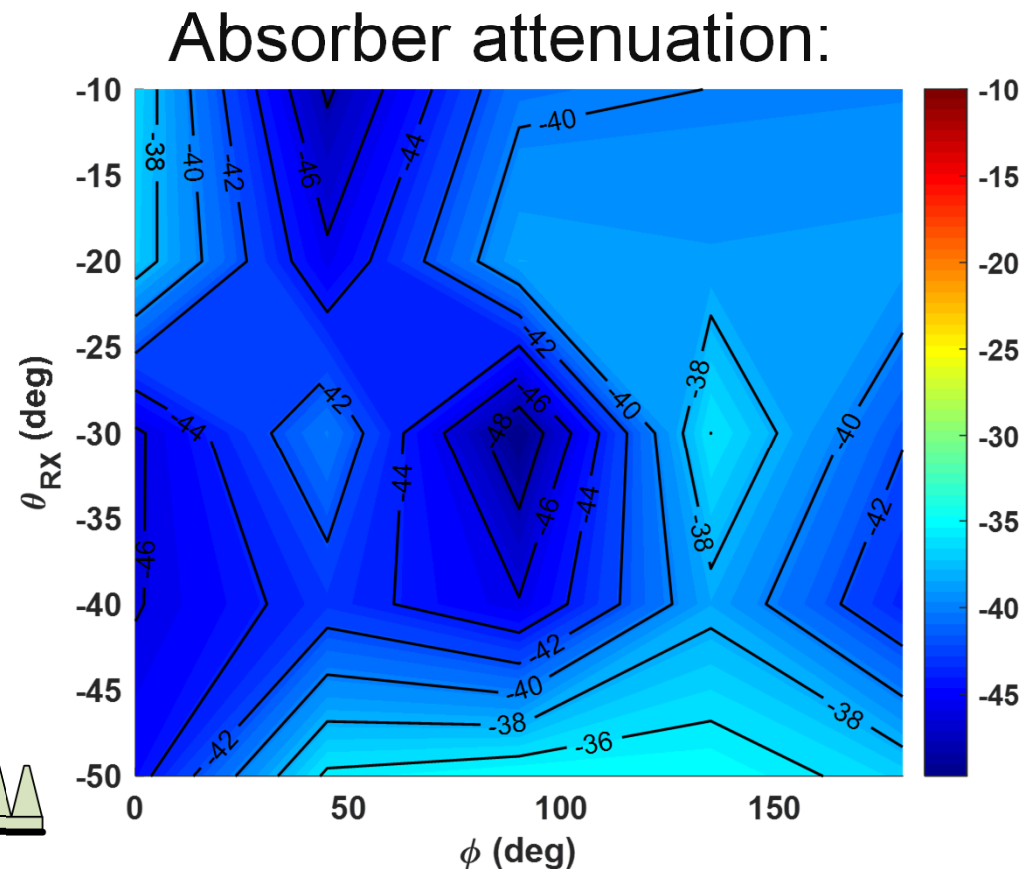
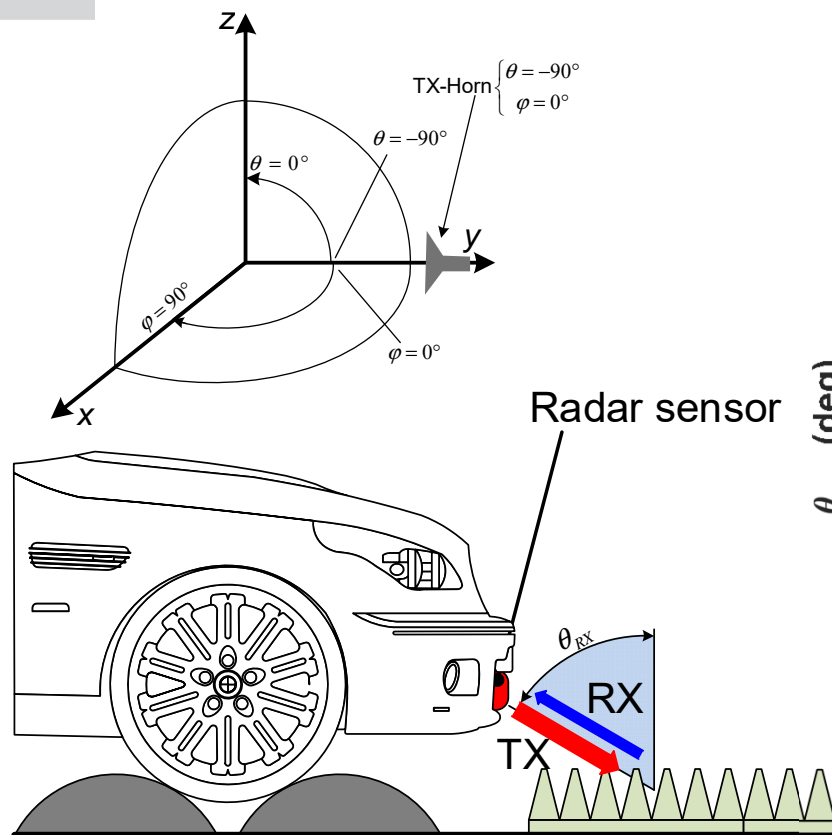


Foam absorbers:



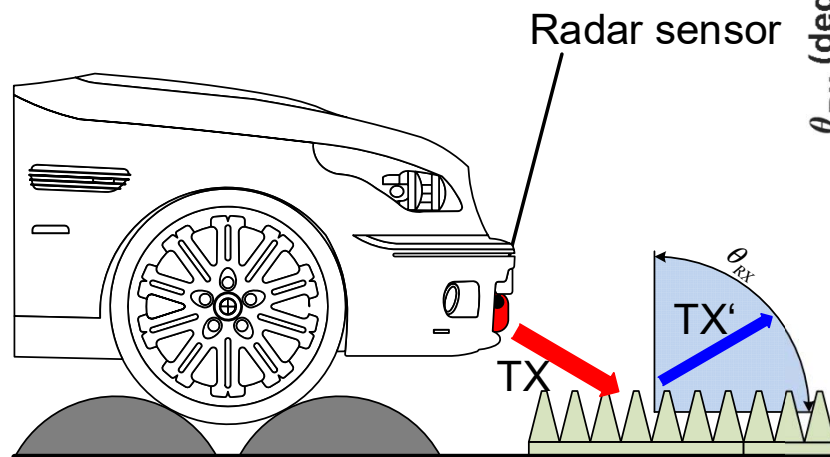
Absorber Characterization Reflection Measurement

Pyramidal absorber, f : 78 GHz, co-polarized, $\theta_{TX}:-60^\circ$

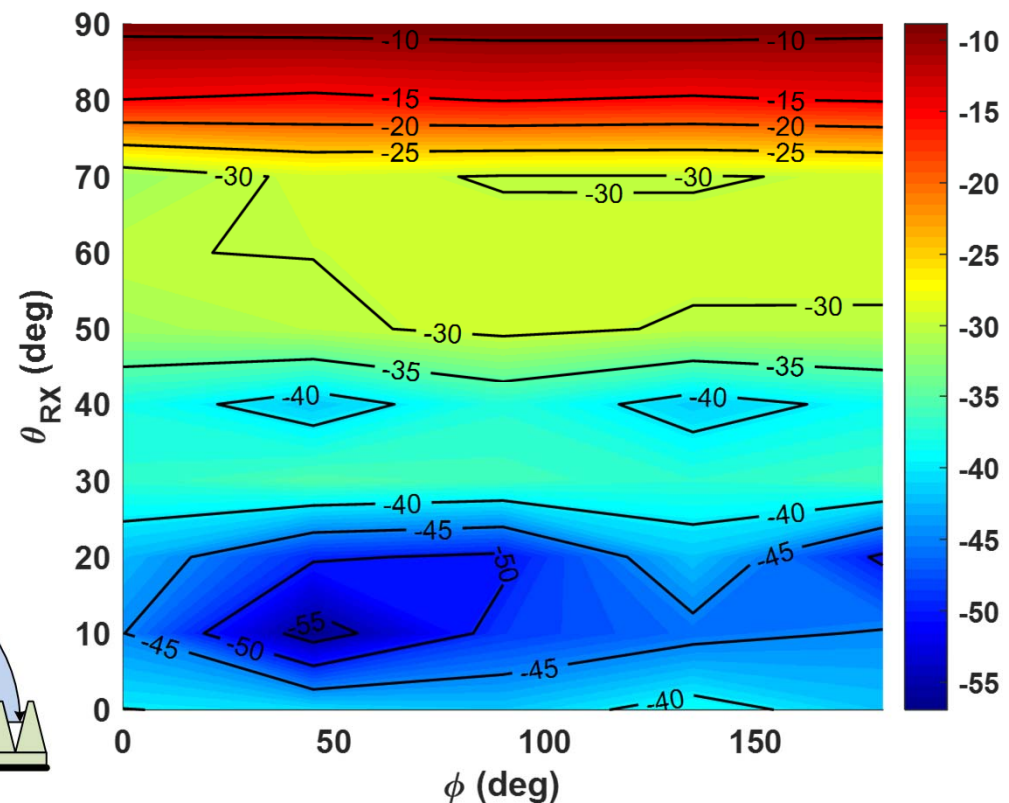


Absorber Characterization Transmission Measurement

Pyramidal absorber, f : 78 GHz, co-polarized, θ_{TX} : -60°



Absorber attenuation:

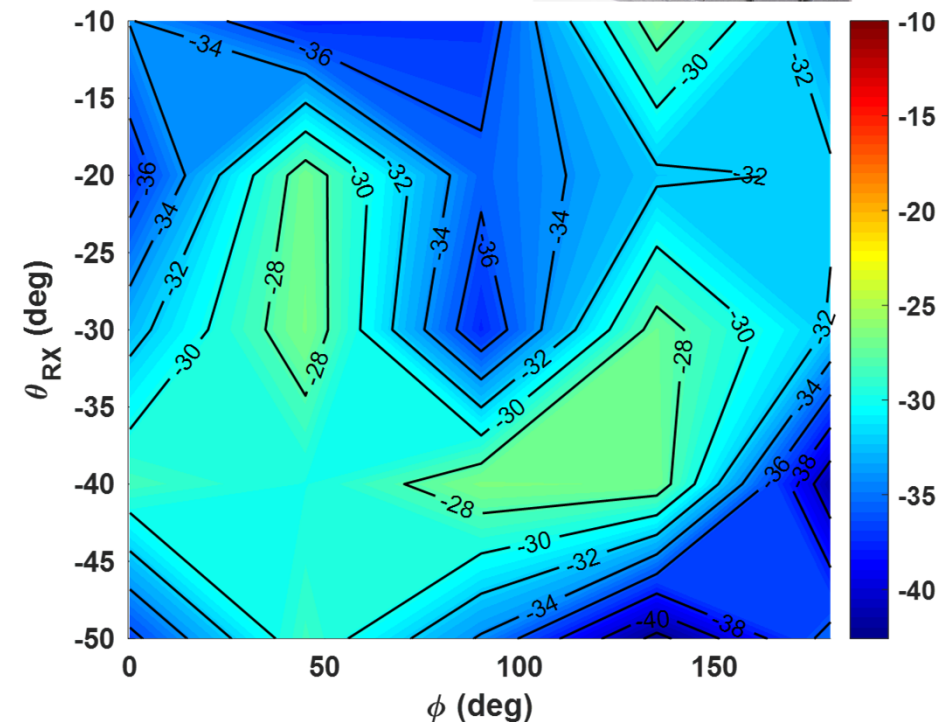
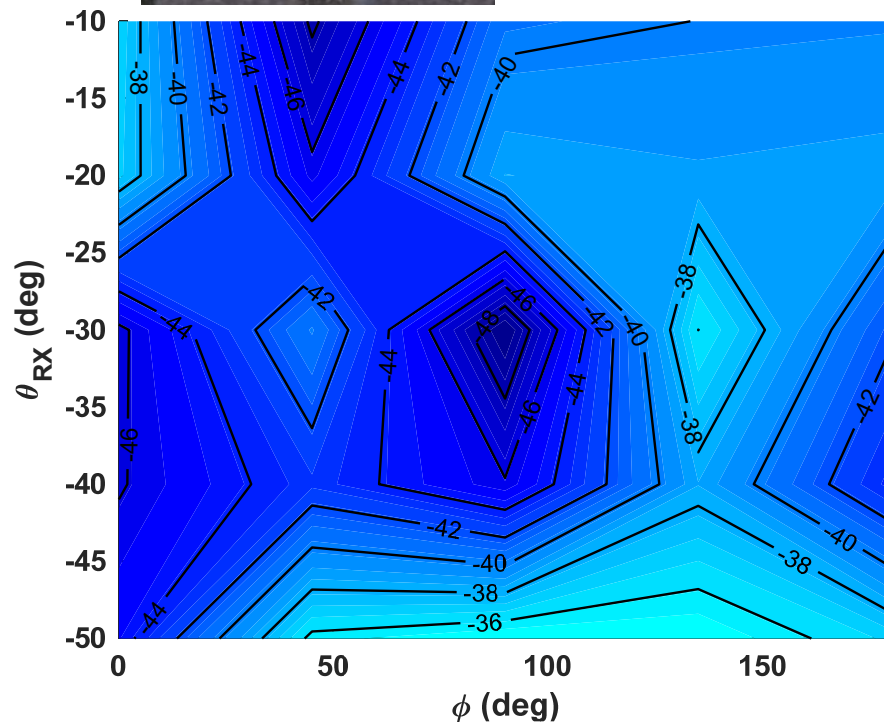
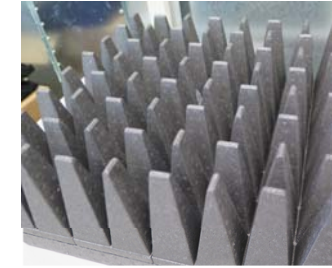


Absorber Characterization

Reflection Measurement Comparison



Absorber attenuation:



Next Steps & Future Challenges

Next steps:

- Implement & optimize the absorber concept at automotive testbeds
- Develop improved antenna design for Radar Target Stimulation

Future Challenges:

- Multi-target objects to trigger object classification of the radar sensor
- New waveforms (OFDM, ...)
- Frequency & bandwidth

Any questions?

W02 Towards Virtual-Drive Testing

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Speaker contact:
michael.gadringer@tugraz.at

