Bundesamt
für Strahlenschutz

**Spotlight on EMF Research**

# Spotlight on “Assessment of SAR in Road-Users from 5G-V2X Vehicular Connectivity Based on Computational Simulations” by Bonato et al. in Sensors (2022)

**Category [radiofrequency, dosimetry/exposition]**

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Competence Centre Electromagnetic Fields (KEMF)

## 1 Putting the paper into context by the BfS

Due to the advancing digitalization a change in the exposure of the general population to EMF (electromagnetic fields) also in the traffic environment is to be expected. In particular the increase of wireless connections between cars (Car2Car communication) and cars with the environment (Vehicle to everything, V2X) adds new RF-EMF (radio frequency EMF) sources. This might affect the exposure of both vehicle occupants and other road users (e.g. pedestrians) who are close to roads or near vehicles equipped with wireless transmitters. For such exposure scenarios, the data on the possible exposures is currently scarce.

## 2 Results and conclusions from the authors perspective

Bonato et al. present the results of a computer simulation in which V2X related RF-EMF exposure of pedestrians is investigated in a generic scenario. For this purpose, a computer model of a passenger car is extended by two transmitting antennas (each consisting of patch antenna array with 8 x 2 elements, 3.5 GHz transmitting frequency, 1W transmitting power, 14 dBi antenna gain, main lobe orthogonal to the antenna plane) and an anatomical computer model of a human (model Ella) is placed at different positions in the immediate vicinity of the passenger car model. The transmitting antennas are assumed to be integrated into the windscreen (main lobe 37° forward/upward) and into the roof plane (main lobe 90° upward) and the exposure of a pedestrian standing either directly frontal in front of the car, behind the car, as well as in the area of the doors on the right side of the car is investigated. In the anatomical human body model, the resulting specific absorption rate averaged over the whole body (whole-body SAR), as well as the local peak SAR value averaged over 10g (10g SAR) are determined using numerical simulations. For the

investigated scenario the authors conclude that most power is absorbed in the tissue areas close to the surface and the maximum local exposure occurs predominantly in the head area. The highest exposure (10g SAR of approx. 0.007 W/kg, whole-body SAR approx. 0.00007 W/kg) which remains significantly below the international recommendations for limiting exposure (ICNIRP 2020), is determined for the situation of a person standing directly in front of the vehicle. This value is significantly lower than the values found in another study [2], in which the exposure from roof antennas (30W transmitting power, 5.9 GHz transmitting frequency) of a vehicle is investigated. The authors attribute this difference to the significantly lower transmitting power in their study.

# 3 Comments by the BfS

The values determined by the authors are not universal and only apply for the investigated scenario. From a radiation protection point of view, realistic worst-case scenarios related to transmitting 5G-V2X equipment are most important. However, it is questionable whether such a scenario has been assessed in the study. The authors modelled a situation where the human body model is hardly exposed by the main lobe of the antennas because a predominantly upward radiating antenna on the car roof and a front antenna integrated into the windscreen that radiates tilted forwards/upwards were used (see Fig.1 in the manuscript and compare the antenna diagram with the antenna positioning on the vehicle). This is not compatible with the literature that the authors cite to refer to planned and existing implementations of 5G-V2X transmitters [3-8]. In fact, predominantly horizontally or omnidirectional radiating antennas are to be expected according to the cited literature [7,8]. In such scenarios, people standing in front of and next to the car would be more exposed than in a scenario with predominantly upwards radiating antennas. It can therefore be assumed that higher exposures are to be expected in a realistic worst-case scenario, even though the modelled antenna output power of 1 W is greater than the permitted 0.2 W output power given by the technical specification [3-6].

In conclusion, from a radiation-protection perspective, a focus on realistic worst-case exposure scenarios would be helpful.

# References

The first reference is always the manuscript at hand and the reference in the curly braces at the end of a reference {xx} correspond to a reference in the manuscript at hand and is consistent with the manuscripts reference style.

[1] Bonato, M.; et al. Assessment of SAR in Road-Users from 5G-V2X Vehicular Connectivity Based on Computational Simulations. Sensors 2022, 22, 6564. https:// doi.org/10.3390/s22176564

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[7] Artner, G. et al. Automotive Antenna Roof for Cooperative Connected Driving. IEEE Access 2019, 7, 20083–20090. {43}

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Bundesamt für Strahlenschutz
Postfach 10 01 49
38201 Salzgitter

Tel.: +49 30 18333-0
Fax: +49 30 18333-1885
E-Mail: spotlight@bfs.de
De-Mail: epost@bfs.de-mail.de

www.bfs.de

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