Uncertainty in determining respect distance for electromagnetic fields by spatial interpolation of exposure indices

N. Zoppetti[(1)], D. Andreuccetti[(1)], S. Ceccherini[(1)], M. Comelli[(1)], S. D'Agostino*[(2,3)] and R.Falsaperla[(2)]
(1) Institute of Applied Physics "Nello Carrara" of the National Research Council, Sesto Fiorentino, Italy, email: n.zoppetti@ifac.cnr.it; d.andreuccetti@ifac.cnr.it; s.ceccherini@ifac.cnr.it; m.comelli@ifac.cnr.it
(2) Department of Occupational and Environmental Medicine, Epidemiology and Hygiene, INAIL, Italy; e-mail: s.dagostino-sg@inail.it; r.falsaperla@inail.it
(3) Department of Information Engineering, Electronics and Telecommunications, Sapienza University of Rome, Italy; e-mail: simona.dagostino@uniroma1.it

Exposure indices are significant quantities in the assessment of human exposure to electromagnetic fields, especially in the work environment, because they consider both the field spectrum and the frequency dependency of regulatory limits. Some measurement instruments available on the market allow to measure these indices, by expressing them as a percentage or unit value. In many situations, a parameter that allows to characterize the exposure and give synthetic and effective indications on risk assessment and risk reduction is the respect distance, i.e. the distance from the source beyond which the exposure index considered is less than 100% (or unity, depending on adopted standardization). This definition implicitly assumes that a reference direction has been chosen so that, moving away from the source along it, the intensity of the exposure decreases with the distance itself. This work describes how the respect distance could be determined starting from exposure index measurements, thanks to a flexible interpolation method to be used in combination with different source models and that allows to propagate the uncertainty of each measurement on the result of the interpolation and therefore determine the uncertainty related to the respect distance. As a demonstration, the method is tested in conjunction with a generic source model and a set of measurements of exposure index referred to an arc-welding device, as showed in Figure 1.

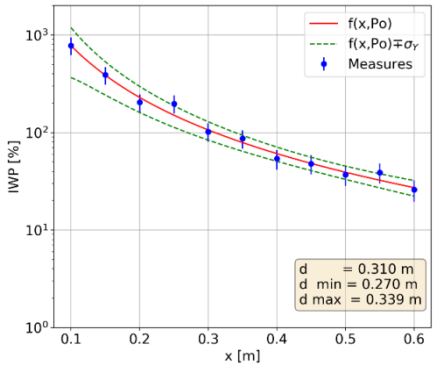

Figure 1. Interpolation of the weighted peak exposure index measured in the vicinity of an arc-welding device: d=31cm is the nominal respect distance, d min =27 cm and d max = 33,9 cm are the values evaluated propagating the measurement uncertainty considering a coverage factor k=1.

The presented method is well suited to be integrated into occupational exposure assessment protocols, since it has the advantage of providing a synthetic but comprehensive and ready-to-use result, considering multiple measurements. The method has been implemented as an online application, equipped with a clear operating interface, which allows the user to manage the selection of the data to be processed and the personalization of the processing results in a flexible and complete way. This application is distributed through the free access WebNir platform [2], developed with the financial support of INAIL, as part of the ID-30 Bric-2016 Call Project.

References

[1] N.Zoppetti, A.Bogi, I.Pinto, D.Andreuccetti *Evaluation of human exposure to complex waveform magnetic fields generated by arc-welding equipment according to european safety standards*, Radiat Prot Dosimetry, vol. 163, no 3, pp. 292-305, 2015. [Online]. Available: doi:10.1093/rpd/ncu188

[2] D.Andreuccetti, M.Comelli, N.Zoppetti, WebNIR: *Strumenti Web per la valutazione dell'esposizione occupazionale alle Radiazioni Non Ionizzanti*, WebNIR, 2017-2019. [Online]. Available: https://webnir.ifac.cnr.it/