Human Exposure to Electromagnetic Radiation of HF Wireless Power Transmitter: Analytical and Numerical Results

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Introduction

- The purpose of this paper is to address the analytical modelling approach for evaluation of antenna influence on wire structure representation human body model and show how it can be used in defined scenarios.
- For that purpose, as a first step, a simplified approximation of a human body by an equivalent cylinder is applied.

Description of the research problem

- The geometry of interest is related to human body model represented as thin wire structure at defined frequency and small loop antenna with voltage source. It is assumed that human is barefoot placed in free space with arms are in close contact with the human body.

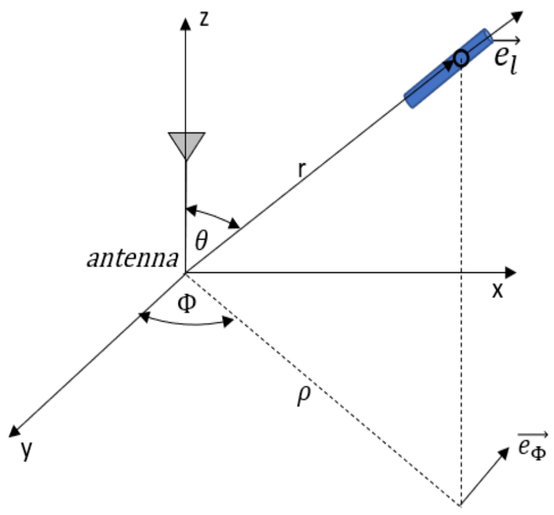

Fig. 1. Near field modeling with TE10 mode.

Research methodology

- Analytical approach involves the use of the approximate sinusoidal current distribution and analytical evaluation of field integrals.
- The results obtained analytically are validated by numerical simulations in commercial software FEKO, based on Method of Moments (MoM) for wire antenna modelling whereas surface equivalent principle (SEP) is applied for homogeneous dielectric bodies of simplified shape.

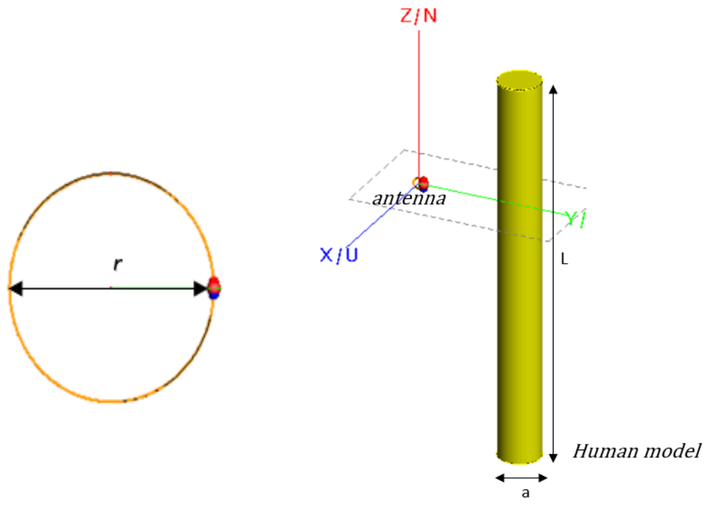

**Fig.2. (a) Geometry of antenna,
(b) simplified cylinder human body model standing in free space and transmitter antenna.**

Results

- It is evident that all curves have the same behavior. Also, analytical results are slightly lower in amplitude.
- The maximum electric field E and current density values J are obtained in human model at 1.2 m because the position of transmitter antenna and voltage source.
- Obtained results are below the prescribed recommendations for general (P) and professional population (W), as shown in Table II.
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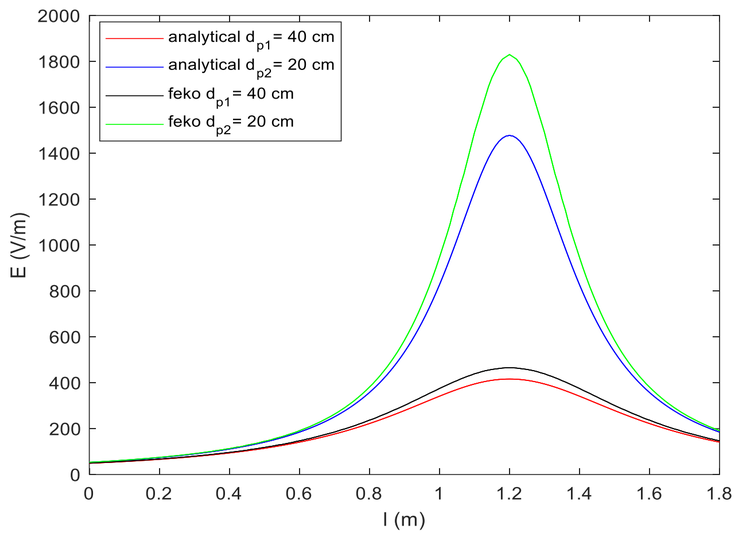

Fig.3: Total electric field *E* distribution along the cylinder human body model (in FEKO simulated at defined distance without human body model).

TABLE I. Comparison of the current density *J* top value with basic INCIRP and Croatian recommendations

Current density (J) calculated top value [A/m²]					Basic INCIRP and Croatian recommendations J [A/m²]	
f (Hz)	FEKO		ANALYTIC		P	W
	d_{p1}	d_{p2}	d_{p1}	d_{p2}	10	50
13.56 M	4.55	9.43	3.93	8.35		

Conclusion

- The method presented in this work can provide rapid estimation of the phenomena and the obtained results can be of practical use in an engineering sense.
- Therefore, the main feature of the method presented so far is related to the simplicity and efficiency.

References

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