IGCESH2014
Universiti Teknologi Malaysia, Johor Bahru, Malaysia 19-21 August 2014

INVESTIGATION OF SYMMETRICALLY CRUMPLED FLEXIBLE DIPOLE ANTENNA IN THE VICINITY OF THE HUMAN BODY

N. A. Elias[1], N. A. Samsuri[2], M. K. A. Rahim[3] and N. Othman[4]

[1, 2, 3, 4] Radio Communication Engineering Department (RaCED), Universiti Teknologi Malaysia, Johor, MALAYSIA.
(E-mail: norfae89@gmail.com, asmawati@fke.utm.my, mkamal@fke.utm.my, nazirah.othmann@gmail.com)

INTRODUCTION

Nowadays, textile wearable antennas have received growing interest to be implemented in the Body Area Network communications (BANs) technology due to its flexibility and easiness to be integrated into the clothing [1-4]. In reality, human body movement will bend, crumple or even twist the antenna due to the flexible nature of the antenna. Therefore, the antenna performance under crumpling conditions and the presence of human body is investigated in this study. The safety aspects of the user also need to be taken into account to prevent any adverse health effect. Therefore, this study will also investigate the effect of antenna crumpling towards the power absorbed by the human body. Basically, Specific Absorption Rate (SAR) is a standard unit to indicate the amount of power absorbed per unit mass of human biological tissue when exposed to electromagnetic radiation.

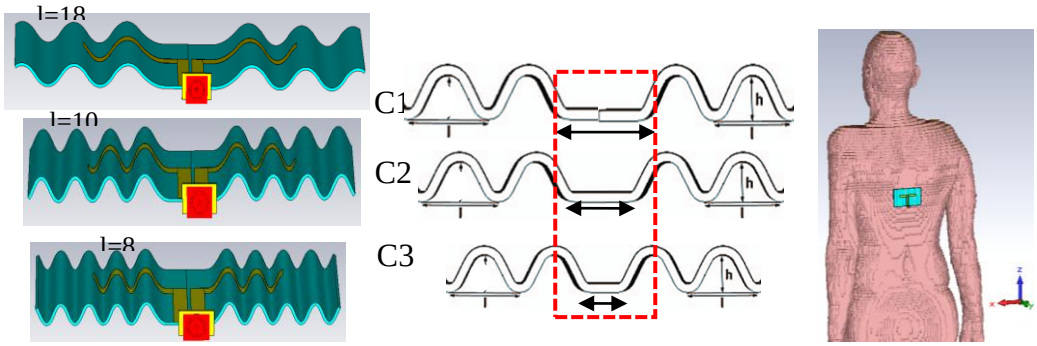

Figure 1. Simulation setup for the symmetrically crumpled antenna.

The denim textile antenna operating at 2.4 GHz is crumpled symmetrically by varying the length of the crumple, *l* and the distance of the crumple from the port; C1, C2, C3, as depicted by Figure 1. Smaller *l* indicated a higher amount of curvature while larger *l* represents lower amount of curvature. The antenna is placed on the back of CST voxel family of Gustav (38 years old male) containing detailed organs model. The antenna

position and distance from the body is kept constant for all crumpling cases investigated.

MAIN RESULTS

It is well known that an antenna may behave in very different ways whenever placed in several distance away from and close to the human body. The effect of human body on the input impedance and radiation pattern of an antenna is significant. Reduction of input impedance due to the human body is observed for all crumpling cases. Surprisingly, symmetrical crumpling will have more prominent effect on the antenna resonant characteristics compared to uncontrolled crumpling [5]. Antenna crumpled by smallest *l*, (*l*=8 mm) shows the highest SAR increment as depicted by Figure 2. The more the antenna is crumpled, the higher the SAR value and thus the power absorbed by the body. The result also shows that the distance of the crumple from the port will influence the SAR value.

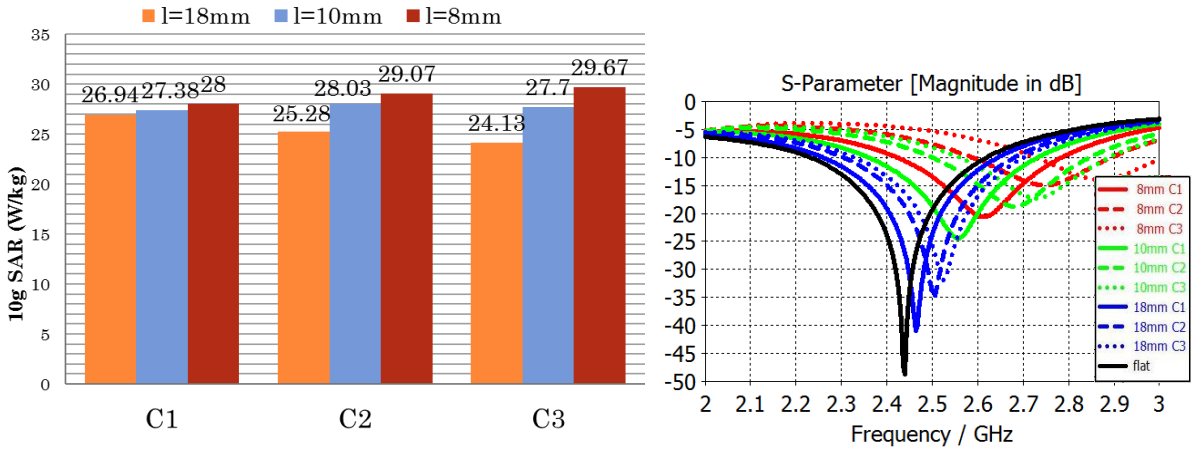

Figure 2. Peak 10g SAR value inside the human back and the resonant frequency for different symmetrical crumpling conditions.

Acknowledgment: The authors would like to express their appreciation for the support from Universiti Teknologi Malaysia (UTM) and Universiti Teknikal Malaysia Melaka (UTeM) under grant no Q.J130000.2523.04H23.

REFERENCES

1. M. A. R. Osman, M. K. A. Rahim, M. Azfar, N. A. Samsuri, F. Zubir, and K. Kamardin, "Design, implementation and performance of ultra-wideband textile antenna," Progress In Electromagnetics Research B, vol. 27, pp. 307-325, 2011.
2. N. K. Chahat, N. Zhadobov, M. Sauleau and R.nIto, "Design and characterization of an UWB wearable antenna," 2010, pp. 461-464.
3. M. A. R. Osman, M. K. A. Rahim, N. A. Samsuri, H. A. M. Salim and M. F. Ali, "Embroidered fully textile wearable antenna for medical monitoring applications," Progress in Electromagnetics Research, vol. 117, pp. 321-337, 2011.
4. P. Salonen, Y. Rahmat-Samii, H. Hurme and M. Kivikoski, "Effect of Conductive Material on Wearable Antenna Performance: A Case Study of WLAN Antennas" IEEE Journal, 2004.
5. N. A. Elias, N. A. Samsuri, M. K. A. Rahim, N. Othman, "Investigation of crumpling effects on EM absorption and antenna performance at 2.4 GHz," RF and Microwave Conference (RFM), 2013 IEEE International , pp.395,399, 9-11 Dec. 2013