# Transient Analysis of Electromagnetic Pulse Coupling to Normal Mode Helical Antennas Based on Circuit Models

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The normal mode helical antenna (NMHA) is widely used for RF communication applications and usually provides a potential front door path of coupling electromagnetic pulse (EMP). Many numerical methods are employed to analyze the transient response of antennas under EMP, such as time-domain finite difference (FDTD) and time domain integral equation (TDIF) methods. While the numerical methods give accurate results, they can be time-consuming and only provide snapshots of EMP response in very specific circumstances. In addition, the transient data obtained from numerical tools is often required to be handled for the subsequent EMP vulnerability assessment in the RF front end circuits of communication system. The analysis of transient response for communication systems in the presence of EMP was usually complicated in the traditional field-circuit method.

A reasonably accurate equivalent circuit for NMHAs was recently proposed to represent the antenna impendence and valid from very low frequencies to the first resonant frequency and beyond (Y. Liao et. al., IEEE Antennas Propag. Mag., vol. 62, no. 11, pp. 5885-5888, Nov. 2014). It gives an efficient way to conduct transient analysis of EMP coupling to antennas by using circuit based models.

In this paper, the transient response of NMHAs exposed to EMP is analyzed by using circuit based model, which consists of an equivalent pulse voltage source and an antenna equivalent circuit. The time-domain current response in the NMHA input port could be efficiently obtained with this simple equivalent circuit. Validation is made and the results from the circuit based models agree well with data obtained from full numerical solution of the actual antennas. The equivalent circuit models can be readily used to circuit simulation of communication system and could speed up the EMP vulnerability assessment. More details about the comparisons between circuit based models and actual numerical models will be presented in the conference.