EFFECTS OF WINDOWS AND PEOPLE ON ELECTROMAGNETIC FIELDS INSIDE CONDUCTING ENCLOSURES

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Abstract:

When mobile communications devices are used in aircraft and trains, the metallic compartment may act as a resonant cavity, enhancing the internal electromagnetic fields. It is therefore important to understand the effects of human bodies and apertures on these resonances. To investigate this we have performed measurements of propagation in a resonant chamber at 900-920MHz, and analysed the results by a combination of statistical methods and computational electromagnetic modelling. At such frequencies the chamber is electrically large and behaves as an over-moded cavity. The propagation was measured firstly with the chamber empty, then with absorbing material on the walls to simulate the windows, and finally with the room populated with a similar passenger density as might be seen in a commercial airliner. The presence of the human bodies leads to a smoother frequency response and also a reduction in the transmission between two antennas of 15 to 20dB. A statistical model for this behaviour is to calculate all resonant modes using the Helmholtz equation, and then combine modes with random coefficients, assuming that each mode has a Lorentzian line shape. By calculating the frequency response in this way, and then calculating the autocorrelation function of the results, we found that the greater the Q-factor, the narrower the peak in the autocorrelation function. We performed the same procedure on the experimental data and by comparing graphs were thus able to estimate that the average Q-factor of the empty chamber was about 13000. However this was reduced to 700 for windows only, to 300 for nine passengers seated and to 180 for nine passengers standing. We also modelled the propagation in the room using the transmission line matrix (TLM) method, which gives not only the frequency response but also the field distribution at a particular frequency. The grid size was 30mm, and partially-reflective boundaries simulated energy losses through the windows and in the bodies of the passengers. This enabled us to observe the reduction in Q-factor and the changes in the statistical distribution of electric field strengths due to the presence of windows and passengers.