Numerical Simulation of a Human Body Subjected to Electrostatic Fields for Study of the Turin Shroud Body Image

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Abstract

The TS (Turin Shroud) [1,2] is a fine linen fabric showing a not yet explainable [3] double body image of a scourged and crucified man stabbed on the side. Many hypotheses have been formulated without success [4] and perhaps the most reliable is one correlated to the Corona Discharge [5] that supposes the presence of an intense electric field, amplified by the presence of ionization induced by radon. Before to formulate specific hypotheses regarding the environmental conditions, that will be studied in the future, the analysis focalizes the interest on the verification of the effects of such an electric model on a linen sheet. Therefore the first steps is to simulate the electrostatic field distribution along a two-dimensional sheet enveloping a numerical manikin of a human body having his position coherent with that detected on the TS [6]. Two of the authors [7] have already performed a preliminary analysis using a rough numerical manikin composed of 11 ellipsoids. The results of a more detailed numerical manikin, in which there are also reproduced the hair, the hands' fingers and some detail of face, like nose and eyes (Figure 1), are here presented and discussed. This improvement seems necessary because the interest on the TS image is also addressed to these details. The numerical manikin with its boundary conditions was implemented in the COMSOL Multiphysics 4.2a software. During the preprocessing phase it has been chosen a second order interpolation in the element (tetrahedrons) composing the mesh that was built in a domain given by the volume difference between a parallelepiped and a manikin; the elements sizes ranges from 0,0001 to 0, 01 m. Starting from the hypothesis that the superficial intensity of the electrostatic field is proportional to the image intensity codified on the linen sheet, the aim of this study is to show which is the best environmental condition, if any, from an electric point of view, that produces an image as similar as possible to that of the TS. Different electrical ambiences were considered and simulated. For example the results reported in Figure 2 and Figure 3 are relative to a floating conductive manikin posed in a parallelepiped having isolated lateral walls, whose roof is an equipotential surface of 1 V and whose floor is grounded. Parallelepiped's sizes are of 0.5, 0.2, and 0.2 m and the manikin is in the middle of it. The electric field on the manikin's surface has been evidenced with a maximum value, relative to the present simulation, of about 49 V/m. The peaks of the electric field are mainly due to the manikin's jags such as the nose, but there are also some angularities of the mesh, for example in correspondence of the hands, that produce not real peaks in electric field and this limit of the numerical model must be considered. The supposed proportionality

between the electric field intensity and the luminance levels of the codified image on the TS linen sheet, allows to compare the results showing a general similitude but still evidencing some incongruence of details like the fingers.

Reference

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Figures used in the abstract

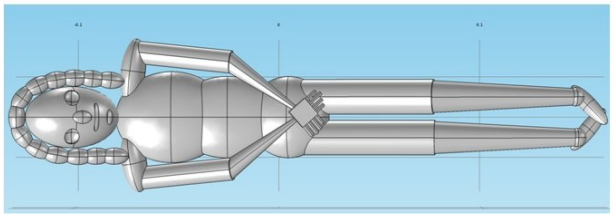

Figure 1: Numerical manikin built for the electrostatic simulation.

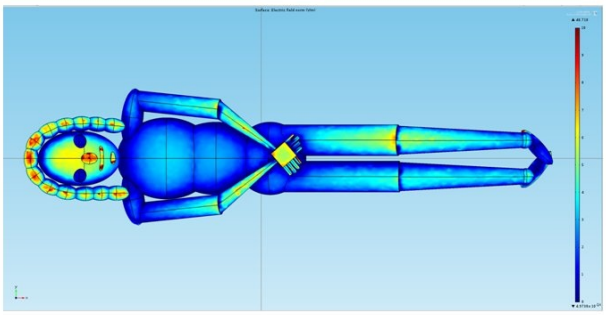

Figure 2: Resulting electrostatic field distribution on the manikin surface, upper view.

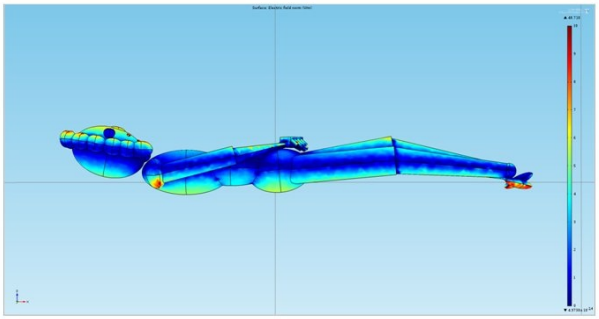

Figure 3: Resulting electrostatic field distribution on the manikin surface, side view.