Application for Construction and Numerical Analysis of New Melting Elements

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Abstract

ETI is one of the world's leading manufacturers of fuses. Different standard sizes, rated voltages, rated currents and tripping characteristics mean more than 750 different types of products. Additionally, our customers sometimes require fuses specifically designed for their needs. Our old development process of new melting elements consisted of four steps: 1. designing a melting element (based on experience and approximate calculations of its electrical resistance). 2. Production of tools for the stamping press. 3. Production of fuse prototypes. 4. Measurements and various tests. The whole cycle that took both time and money. With the use of COMSOL Multiphysics®, in the development process, we reduced the number of repetitions of said cycles . In the first step, we change various dimensions of the new melting element, change the number of weakened spots, etc. and its electrical resistance is calculated. We can takes into account the electrical resistance of the contact knives and in the case of parallel connection of several melting elements; the total electrical resistance is calculated. We can also simulate the heating of the melting element during the short-circuit currents up to the point of electric arc formation. The melting element is part of the RL circuit, to which the expected short-circuit current is set. With the increase of an electric current, it begins to heat up; when the temperature in the model exceeds the melting point of the copper, the simulation stops. The model can also be used to perform tolerance analysis of the melting element or DFMEA (Design Failure Mode and Effect Analysis). With the use of the Application builder, we integrated this model in to a form of an application that can be used by an engineer that has practically zero knowledge of CAE or FEA.
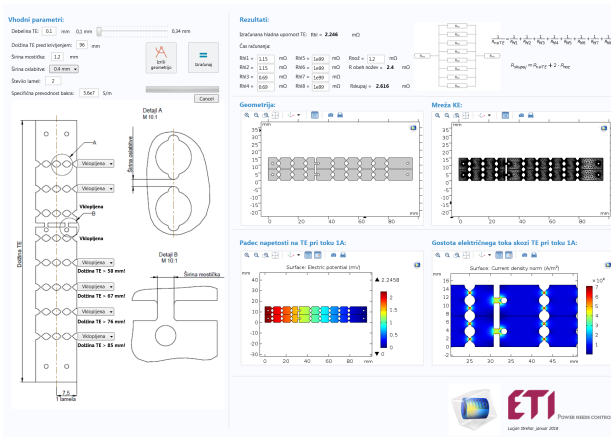
Figures used in the abstract

Figure 1: Application's user interface.