Some Like it Very Hot: Formal Modeling and Analysis of Extreme Heat Exposure to the Human Body in HI-Maude

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Abstract. In this paper we use HI-Maude to model and analyze the human thermoregulatory system and the effect of extreme heat exposure to the human body. The case study is motivated by the 2010 Sauna World Championships, which ended in a tragedy when the last two finalists were severely burnt in surprisingly short time (one of them died the next day). HI-Maude is a recent rewriting-logic-based formal modeling language and analysis tool for complex hybrid systems whose components influence each others' continuous dynamics. One distinguishing feature of HI-Maude is that the user only needs to describe the continuous dynamics of *single* components and interactions, instead of having to explicitly define the continuous dynamics of the entire system. HI-Maude analyses are based on numerical approximations of the system's continuous behaviors. Our detailed models of human thermoregulation and the sauna used in the world championships allow us to use HI-Maude to formally analyze how long the human body can survive when experiencing extreme conditions, as well as analyzing possible explanations for the still unsolved tragedy in the 2010 Sauna World Championships.