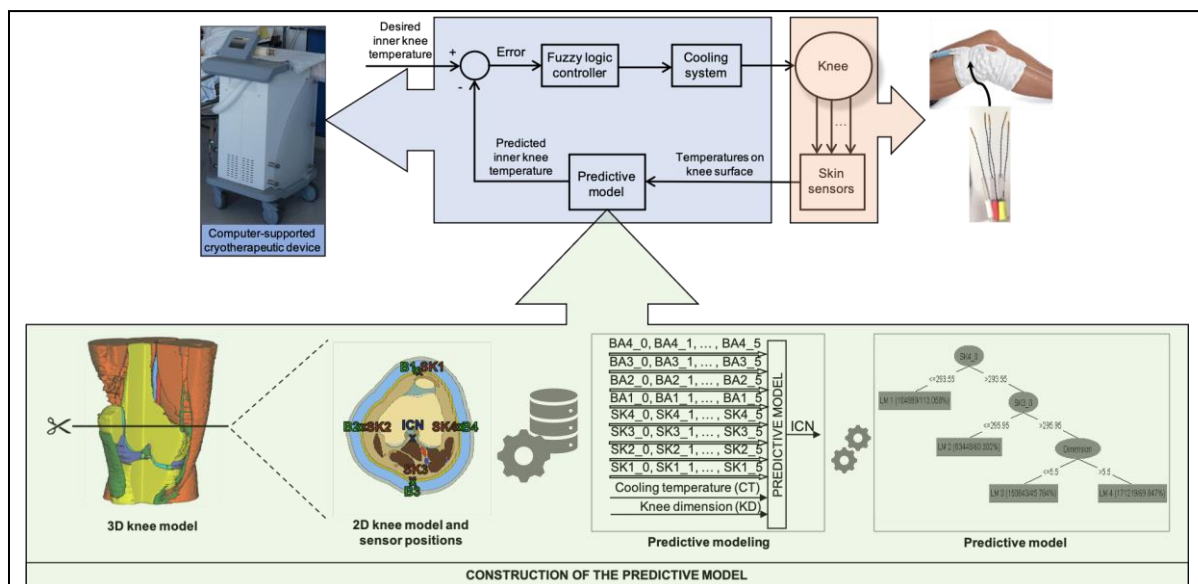


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## Personalized Real-Time Control of Hidden Temperature Variables in Therapeutic Knee Cooling

We have formalized, implemented and evaluated a framework for personalized real-time control of inner knee temperature during cryotherapy. The framework is based on the feedback control loop that uses predicted instead of measured inner temperatures because measurements are not feasible or would introduce invasiveness into the system. It uses machine learning to construct a predictive model for estimation of the controlled inner temperature variable based on other variables whose measurement is more feasible – temperatures on the body surface. The machine learning method uses data generated from computer simulation of the therapeutic treatment for different input simulation parameters. A fuzzy-logic controller is designed to provide real-time control of the inner knee temperature by controlling the cooling temperature. Controlled therapeutic cooling can contribute to the development and standardization of various cryotherapeutic methods. The framework has been protected with a patent (WO2014/180941) and awarded with a special prize for innovations for economy at ITTC 2013.



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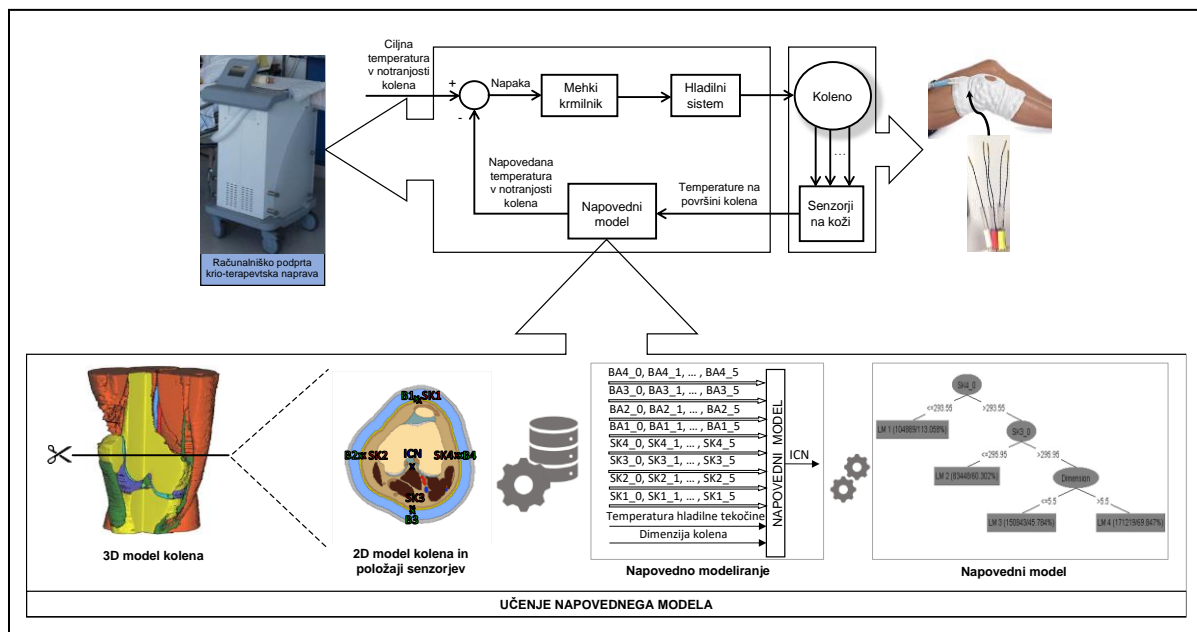
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## Personalizirano vodenje skritih temperaturnih spremenljivk pri terapevtskem hlajenju kolena v realnem času

V okviru problema s področja biomedicine smo razvili programsko okolje za posamezniku prilagojeno vodenje (reguliranje) krio-terapije kolena v realnem času. Cilj programskega okolja je vodenja naprave za zunanje hlajenje kolena na tak način, da notranjost kolena, kjer ni mogoče opravljati meritev temperature, dosega želen potek temperature. Krmilna zanka ima na voljo le merljive spremenljivke, kot so temperatura hladilne tekočine ter temperatura kože na nekaj mestih v okolici kolena. V dosežku smo združili znanje iz treh raziskovalnih področij: s pomočjo numeričnih simulacij prenosa in generacije toplote znotraj človeškega telesa smo pregledali prostor rešitev, s strojnim učenjem smo preslikali s simulacijo pridobljene podatke v napoved skritih spremenljivk, ter s teorijo nadzora razvili ustrezne algoritme vodenja naprave v realnem času. Uporabljen princip vodenja hlajenja lahko prispeva k razvoju in standardizaciji novih krio-terapevtskih metod. Programsko okolje je bilo zaščiteno s patentom (WO2014/180941) in nagrajeno s posebno nagrado za gospodarske inovacije na ITTC 2013.



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