Contact person:

Dr.-Ing. Balint Varga

IRS, Room 105

Tel.: 0721/608-42467

balint varga2∂kit edu

Start: From September 2024

Your Interest:

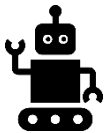|	
Robotics	Applied Mathematics
Mathematical Modelling	Game Theory
Human-Machine Interaction	Optimization

Master's Thesis

The application of game theoretical concept for human-machine interaction for cooperative surgical robotics

Motivation:

Recent years have seen significant attempts to automate various types of surgical interventions. Despite these efforts, the complexity involved suggests that it may take more years to achieve the full automation of these system. The physical interaction between surgeon and operation robots promises a new dimension in the medical field. Such a cooperative setup are useful to teach young surgeons or to help expert surgeons to maintain their maximal performance during the whole day. As a result, better patient outcomes in various kinds of surgical operations. Since these systems are safety critical, model-based methods are required in order to enable the verification and validation of the safety of these cooperative control systems. Robots can also enhance safety by enforcing restrictions and controlling movements, which can be especially beneficial for inexperienced surgeons, making operations safer overall.

Illustration of a prospective input device for collaborative human-machine systems

The goal of this master's thesis is the 1) mathematical modelling of this cooperative interaction in order to 2) build up an assistant system and 3) carry out an exemplary surgical procedure in a test environment.

Task definition:

The first step of the master's thesis is the mathematical modelling of the human-machine interaction, which should happen by mean of the theory of **differential games**. Based on this model, an **assistant cooperative control function** will be implemented in a **simulation setup**. The **model-based control** algorithm should be able take safety. Finally, the cooperative control function will be implemented on an input device for **initial experiments**.

Bildquelle: Eric Wendt, Unsplash.com