

Universitatea Tehnică din Cluj-Napoca
Facultatea de Automatică și Calculatoare
Domeniul: Ingineria Sistemelor
Programul de studiu: Automatică și Informatică Aplicată
anul universitar: 2026-2027

Teme pentru proiecte de diplomă și disertație

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Nr. crt.	Titlul temei	Scurta descriere	Cerințe / Cunoștințe necesare	Nivel (licenta/master)
1	Fractional-order PK/PD identification of propofol from Open TCI plasma concentration data	- Data-driven thesis - Uses open-access target-controlled infusion datasets (opentci.org) pairing drug infusion with measured plasma concentration - Identify a fractional-order compartmental PK/PD model (infusion → plasma concentration) - Compare the fit against the classical integer-order Schnider / Marsh / Eleveld models - Difficulty: medium+	- System identification - Good knowledge of Matlab/Simulink - Interest in modelling physiological systems	Licenta
2	Fractional-order identification of depth of hypnosis from routine infusion–BIS data (no plasma sampling)	- Data-driven thesis - Identify the dose (infusion) → effect (BIS) dynamics directly from intraoperative records (e.g. VitalDB), without plasma concentrations - Estimate the fractional order and compare it with an integer-order effect-site model - Investigate whether the identified fractional order is consistent within the same patient - Difficulty: hard	- System identification - Good knowledge of Matlab/Simulink - Data handling (Matlab/Python)	Licenta
3	Mass-balance-consistent fractional-order compartmental model of anesthetic drug disposition	- Theoretical and simulation thesis - Implement in Simulink a fractional-order 3-compartment PK model that preserves mass balance (avoiding the naive one-order-per-compartment formulation) - Validate against reference concentration curves - Study how the fractional order affects drug accumulation during long infusions - Difficulty: hard	- System identification - Good knowledge of Matlab/Simulink - Fractional calculus basics (will be taught)	Licenta

4	Integer- vs fractional-order PK/PD models of propofol: a population-scale comparison	- Theoretical / data-driven thesis - In-depth state-of-the-art analysis of clinical PK/PD models (Schnider, Marsh, Minto, Eleveld) - Benchmark integer- vs fractional-order models across many patients using standard clinical metrics (MDPE, MDAPE, wobble, divergence) - Difficulty: medium+	- System identification - Good knowledge of Matlab/Simulink - Data handling (Matlab/Python)	Licenta
5	Surgical events as excitation signals for pharmacological system identification	- Simulation thesis - Model discrete surgical stimuli (intubation, incision) as input events to the anesthesia system - Study how much information such events provide for identifying the patient model (experiment-design / information-content analysis) - Compare identification quality with and without events - Difficulty: hard	- System identification - Good knowledge of Matlab/Simulink	Licenta
6	Fractional-order closed-loop control of depth of hypnosis	- Simulation thesis based on a propofol anesthesia benchmark built in Simulink - Single-input single-output control (infusion → BIS) - Design and tune a fractional-order controller and compare it against a classical PID - Evaluate time-in-target (BIS 40–60) and robustness to inter-patient variability - Difficulty: medium+	- Control engineering - Good knowledge of Matlab/Simulink	Licenta
7	Event-based fractional-order control of general anesthesia	- Simulation thesis based on an anesthesia benchmark built in Simulink - Control action triggered by surgical events / threshold crossings rather than periodically - Fractional-order event-based control of the hypnosis (and/or analgesia) loop - Difficulty: hard	- Control engineering - System identification - Good knowledge of Matlab/Simulink	Licenta
8	Extension of the AnestheSIM open-source anesthesia simulator	- Applied software / simulation thesis - Extend the group's open-source anesthesia simulator with new modules: fractional-order patient models, a surgical-event generator, and import of real data (VitalDB / Open TCI) - Add visualization of model uncertainty and controller performance - Difficulty: medium+	- Good knowledge of Matlab/Simulink - Programming (Matlab/Python) - Interest in open-source tools	Licenta
9	Certified fractional-order event-based control of general anesthesia under model uncertainty	- Simulation thesis based on a MIMO anesthesia benchmark (hypnosis + analgesia) built in Simulink - Build uncertainty sets from identification residuals (set-membership / conformal bounds) - Design fractional-order event-based control with provable safety margins (bounded time-outside-target, overdose limits) - Validate on population-calibrated virtual patients (incl. elderly / obese); show where memoryless TCI-based control violates margins the memory-aware controller respects - Difficulty: hard+	- Control engineering - System identification - Good knowledge of Matlab/Simulink	Master