1.1	**Proposal type**	Master thesis project
1.2	**Name**	Agent-Based Modeling for Prediction of Angiogenesis after Burn Injury: A GGH-Based Computational Framework with ODE-Coupled Cytokine Dynamics
1.3	**Description**	Burn injuries trigger complex inflammatory responses involving cytokine release and immune cell recruitment that initiate wound healing processes[2]. A critical aspect of healing is angiogenesis - the formation of new blood vessels that supply nutrients and oxygen to healing tissue. This project focuses on validating and enhancing an existing Glazier-Graner-Hogeweg (GGH) based agent-based model that simulates immune response and angiogenesis following burn injuries [2] through integration of ordinary differential equations (ODEs) for cytokine dynamics data validation[1]. **Objectives:** • Validate and enhance existing GGH-based ABM simulating immune response and angiogenesis following burn injuries through integration of imaging data and ODE-based cytokine modeling [2] • Refine model mechanisms for endothelial cell proliferation, migration, and angiogenic sprouting with enhanced chemotaxis rules based on biological insights[1] • Conduct comprehensive simulation analysis for various burn severity scenarios and cytokine profiles to identify key factors affecting angiogenesis and inflammation **References:** [1] Patrick PG Mulder et al. "Burn-induced local and systemic immune response: systematic review and meta-analysis of animal studies". In: *Journal of Investigative Dermatology* 142.11 (2022), pp. 3093–3109. [2] H Ibrahim Korkmaz et al. "An in silico modeling approach to understanding the dynamics of the post-burn immune response". In: *Frontiers in Immunology* 15 (2024), p. 1303776.
1.4	**Work environment**	Research will be conducted within a computational biology research group specializing in burn injury modeling. The team combines expertise in agent-based modeling, bioinformatics, omics data integration, and neural network development. Access to established frameworks for mechanistic understanding of complement-mediated acute phase responses. The available resources include high-performance computing facilities and comprehensive biological databases. Active participation in research publication contributes to thesis grade evaluation.
1.5	**Expectations**	• Programming proficiency (Python for data analysis and modeling) • Programming proficiency in Python for data analysis, ODE solving, and model implementation • Understanding of agent-based modeling principles and GGH methodology • Mathematical modeling skills including ordinary differential equations for cytokine dynamics • Computational biology knowledge for biological system modeling • Data visualization and analysis capabilities using scientific Python libraries • Ability to work with CompuCell3D simulation environment • Strong analytical and problem-solving skills for complex system modeling
1.6	**Research Tags**	agent-based modeling, angiogenesis, burn injury, GGH method, computational biology, cytokine dynamics, ordinary differential equations, wound healing, inflammation, endothelial cells, CompuCell3D, biomedical simulation, mathematical modeling, systems biology
1.7	**Programmes**	Computational Science (joint degree UvA/VU), Master's in Computational Science, Master's in Bioinformatics, Master's in Biomedical Sciences, Master's in Applied Mathematics
1.8	**Contact**	Roland V. Bumbuc (r.v.bumbuc@uva.nl)