Deutsche Forschungsgemeinschaft (German Research Foundation)
Information for Researchers

Call for Proposals

No. 108 **19 November 2024**

Priority Programme "Autonomous Processes in Particle Technology – Research and Testing of Concepts for Model-Based Control of Particulate Processes" (SPP 2364)

In March 2021, the Senate of the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) established the Priority Programme "Autonomous processes in particle technology – Research and testing of concepts for model-based control of particulate processes" (SPP 2364). The programme is designed to run for six years. The present call invites proposals for the second three-year funding period.

Due to the distributed properties of particles, their processing often prevents extensive automation and autonomous process control, which stands for an autonomous adjustment of the product properties without external intervention. The goal of the planned Priority Programme is therefore the research and testing of methods for an autonomous process control in particle technology. The focus is on the coupling of the material and data streams of the respective unit operations with measurement technology, modelling and control algorithms to form a closed loop for model-based control. After termination of the programme, a new type of 'box of scientific tools' (methods, algorithms, models, data structures and information architectures) should be available, which will allow a reliable process control where the tool can also be transferred to new particle processes.

In detail, the thematic goals can be formulated as follows:

- investigation of the process dynamics of individual process steps and of the interconnection of unit operations to form a process chain with material and energy recycles;
- optimisation of different target functions with regard to the pursued property distribution and resource efficiency;
- ensuring the stability of the process chain according to the influence of uncertainties, perturbations and constraints.
- In addition, there are the methodological objectives:
- coupling of material and data streams of the unit operation or within process chains of the process models, the measurement methods and the control technology to ensure an autonomous process;
- extension of methods for in-situ measurement of particle or product properties by means of reconstruction of easily accessible measurement information.

To achieve these goals, models suitable for control, in-situ measurement techniques and powerful methods of process control are required. These are to be developed in close cooperation between

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scientists from the fields of particle technology, control / process system engineering and computer science / mathematics.

The focus is on multiphase, particle processes in which solids or also fluid particles are processed. The typical unit operations of particle technology serve as processes, e.g. processes of particle synthesis (synthesis in the gas or liquid phase, crystallisation, precipitation, etc.), methods of particle processing (comminution, agglomeration, separation, etc.) or processes for product formulation (extrusion, coating, drying, etc.). The processes themselves can be carried out in batch as well as in continuous operation.

In the first period, the SPP was divided into three topics: the development of models suitable for control (modelling), measuring systems for the in-situ acquisition of product properties (measurement technology) and development of concepts for model-based control of particle technology processes (process control). The goal was to close the control loop with the interconnection of the three topics as the basic structural element.

In the second phase of the SPP, process chains consisting of two or more basic operations should be considered, e.g. particle synthesis with mechanical liquid separation or washing, gas phase synthesis with subsequent coating or separation of the particles, emulsion polymerisation with solvent exchange or comminution with classification and additional product formulation.

The equipment and information technology interconnection to form a process chain enables investigations into the interaction between the basic operations and their mutual influence. An optimal operating point of a single process step does not guarantee an optimal operation of the entire chain. At this point, extensive research work is conceivable, such as the investigation on the nonlinear behaviour of a process step in interaction with the other basic operations or with material feedback, the behaviour of disturbances within a basic operation and their impact on the entire chain, or the study of the interactions between the digital representation and the real process within a specified operating window. In addition, the approach could also include strategies for the independent start-up and shutdown of a complete process chain or the ability to handle material or information returns. Energetic couplings or raw material efficiency could also be taken into account, both within a process step and along the process chain.

It is desired that a project is carried out in close cooperation between the disciplines with the respective project focus for the description of the process chain (tandem projects).

The further development of unit operations is not intended in this programme. The objective is to equip existing machines and devices with the necessary measurement technology and actuators. The material streams should then be interconnected with new powerful algorithms for the model-based control. The focus is exclusively on basic developments using small laboratory and pilot plant systems. In the same way, pure method developments without an application within the closed loop are to be excluded.

Proposals must be written in English and submitted to the DFG by **1 April 2025.** Please note that proposals can only be submitted via elan, the DFG's electronic proposal processing system.

Applicants must be registered in elan prior to submitting a proposal to the DFG. If you have not yet registered, please note that you must do so by **24 March 2025** to submit a proposal under this call; registration requests received after this time cannot be considered. You will normally receive confirmation of your registration by the next working day. Note that you will be asked to select the appropriate Priority Programme call during both the registration and the proposal process.

If you wish to submit a proposal for a new project within the existing Priority Programme, please go to Proposal Submission – New Project – Priority Programmes and select "SPP 2364" from the current list of calls. Previous applicants can submit a proposal for the renewal of an existing project under Proposal Submission – Proposal Overview/Renewal Proposal.

When preparing your proposal, please review the programme guidelines (DFG form 50.05, section B) and follow the proposal preparation instructions (DFG form 54.01). These forms can either be downloaded from our website or accessed through the elan portal.

The proposal review process will include a colloquium with direct presentations and discussions between applicants and reviewers, scheduled to take place on **26 June 2025** in Karlsruhe. Any other relevant updates will be communicated in due course via the official DFG channels and the Priority Programme website.

The DFG strongly welcomes proposals from researchers of all genders and sexual identities, from different ethnic, cultural, religious, ideological or social backgrounds, from different career stages, types of universities and research institutions, and with disabilities or chronic illness. With regard to the subject-specific focus of this call, the DFG encourages female researchers in particular to submit proposals.

Further Information

More information on the Priority Programme is available at:
www.mvm.kit.edu/SPP2364_APP.php

The elan system can be accessed at:
https://elan.dfg.de/en

DFG forms 50.05 and 54.01 can be downloaded at:
www.dfg.de/formulare/50_05
www.dfg.de/formulare/54_01

For scientific enquiries, please contact the Priority Programme coordinator:
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