PROCESS SYNTHESIS AND PROCESS DYNAMICS

PSD

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The research group develops methods and tools for the analysis, synthesis and control of complex process systems. Recently, focus has been on modeling and control of particulate processes and preparative chromatographic processes, mixed integer optimization of novel chemical processes from renewable resources as well as novel modeling concepts for biological processes.

DATA-DRIVEN SYSTEM REDUCTION AND IDENTIFICATION

MAX PLANCK FELLOW GROUP

DRI

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The group conducts research in the area of numerical simulation of complex data. The scientists focus on dynamical systems and computation including model reduction of large-scale systems using data-driven approaches. They are a principal tool in the modeling, prediction, and control of physical phenomena ranging from heat dissipation in complex microelectronic devices, to vibration suppression in large wind turbines, to storm surges before an advancing hurricane. The thrust of the research activities of the DRI group is data-driven model reduction, with the Loewner framework as main tool, a direct interpolatory data-driven model order reduction and model identification approach.

ANALYSIS AND REDESIGN OF BIOLOGICAL NETWORKS

ARB

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Our research lies at the intersection of (micro)biology, informatics, mathematics, and engineering sciences. We develop and apply methods from systems and computational biology and combine dry-lab and wet-lab investigations to analyze cellular (biomolecular) networks and to rationally modify them for biotechnological applications.

MOLECULAR SIMULATIONS AND DESIGN

MSD

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This interdisciplinary working group uses expensive computational simulation methods from physics and chemistry, in order to rationalize the interactions between molecules over different time scales. In this way, innovative novel materials for energy systems and sustainable chemistry can be developed. Investigating large proteins on high-performance computing systems allows to understand the dynamics and mode of operation of certain classes of proteins and this leads to the development of novel therapeutic molecules.

ELECTROCHEMICAL ENERGY CONVERSION

EEC

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The group aims to find suitable solutions for the storage of renewable energies with the help of electrochemical processes. Our special focus is on new electroenzymatic processes as well as on developing advanced diagnostic methods for fuel cells and water electrolysis.

By Plane

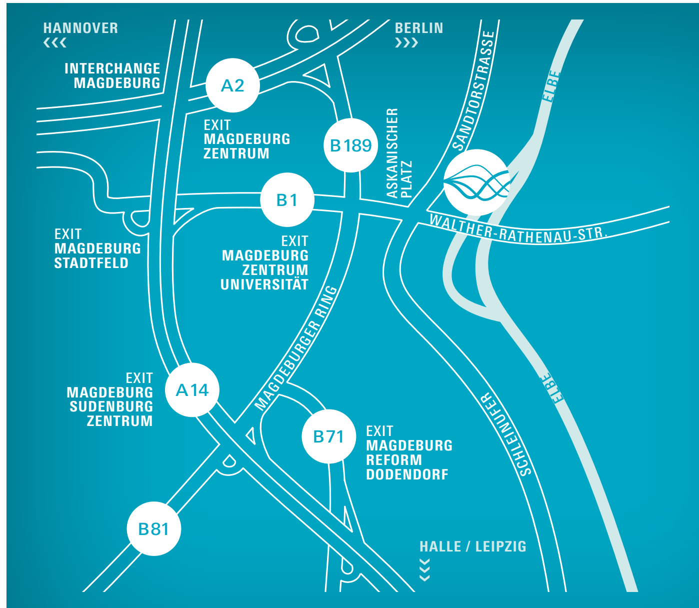
I Close airports are Hanover (140 km), Leipzig (150 km) or Berlin (150 km) I From there, take the train to Magdeburg

By Train

I With the Deutsche Bahn (DB) to station Magdeburg-Hauptbahnhof (www.bahn.de) I From tram station "Alter Markt" take tram number 5 with direction "Messegelände". It is a ten minutes ride I Please get off at station "Askanischer Platz" I From there you walk over the crossroad (Walter-Rathenau-Strasse) towards Sandtorstrasse where you will find the Max Planck Institute on the right side I Timetables: Magdeburger Verkehrsbetriebe www.mvbnet.de

By Car

I Leave the highway (Autobahn) A2 at exit Magdeburg Zentrum I Turn southwards onto B 189 (Magdeburger Ring) direction Halle and leave at exit Zentrum/Universität, direction B1 (Burg/Dessau) I Follow the street signs towards B1 and go straight through the tunnel Universitätsplatz and continue on B1 I Turn left towards Rothensee/Hafen at the traffic lights before crossing the bridges (Elbbrücken) I The Max Planck Institute is directly on the right hand side I Parking place is available at the institute



MAX PLANCK INSTITUTE
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As of: October 2020

MAX PLANCK INSTITUTE
FOR DYNAMICS OF COMPLEX
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MAGDEBURG

Creating knowledge, broadening horizons

ABOUT THE INSTITUTE

The dynamics of recent global economic and ecologic changes necessitate both the development of sustainable production processes and the establishment of future-oriented technologies. This applies particularly to the more efficient production of chemicals and (bio)pharmaceuticals as well as to the transformation and storage of renewable energies.

The main goal of the **Max Planck Institute for Dynamics of Complex Technical Systems in Magdeburg (MPI)** is to contribute to the establishment and design of processes with ever-increasing complexity and to their economic, safe and efficient operation.

MPI scientists from different disciplines such as process engineering, chemistry, biology, biotechnology, mathematics and computer sciences develop mathematical models and computer-aided methods to simulate dynamic processes and describe their complex behavior in detail. Based on an analysis of the respective system properties, innovative approaches are developed and comprehensively evaluated. Model validation and testing of new concepts are supported by extensive experimental studies both at the laboratory and at the pilot scale level.

The MPI, founded as the first engineering institute of the Max Planck Society, started its scientific work in Magdeburg in 1998 and currently employs about 230 people. The MPI is one of 86 institutes and research units working under the aegis of the **Max Planck Society** for the Advancement of the Sciences, a non-profit organization dedicated to the natural and engineering sciences, the humanities and medicine. The current research focus of the institute is on the areas of chemical process engineering, bioprocess engineering, systems biology and synthetic biology, numerical mathematics, energy und process systems engineering as well as systems and control theory.

The **International Max Planck Research School Magdeburg,** a cooperation of the Max Planck Institute and the **Otto von Guericke University Magdeburg**, provides an excellent training and research program for Ph.D. students.

BIOPROCESS ENGINEERING

BPE

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Our focus is on the analysis, design and optimization of bioprocesses for manufacturing of biopharmaceuticals, especially of vaccines and recombinant proteins. Our research includes high cell density cultivation of mammalian cells and establishment of downstream processes, synthetic glycobiotechnology, molecular biology, methods of high-throughput bioanalytics as well as mathematical modeling of biological systems and processes. Current core areas: viral vaccines and viral vectors, defective interfering particles (DIPs), single cell analysis, glycosylated proteins, glycopetide analysis, mathematical modeling of cell growth and virus replication.

COMPUTATIONAL METHODS IN SYSTEMS AND CONTROL THEORY

CSC

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In silico optimization and control of complex technical processes rely on accurate and fast computational methods. For this, the group develops and analyzes mathematical algorithms and methods. Special emphasis is given to computer-aided control system design with a focus on dynamical systems, but other areas in computational science and engineering are also considered. The employed techniques include advanced numerical (multi-)linear algebra, model order reduction/system approximation, machine learning and high-performance computing.

PHYSICAL AND CHEMICAL FOUNDATIONS OF PROCESS ENGINEERING

PCF

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Main focus of the research group is the development of advanced separation and reaction processes. For isolating specific target molecules out of complex mixtures we apply in particular crystallization-based, chromatographic separations and solid-liquid extraction. To identify and develop new generic process options, we undertake systematic experimental and theoretical investigations, with both model systems and industrially-relevant compounds. Directly connecting continuous reaction and separation steps, and the application of forced dynamic operation, are current objects of investigation.

PROCESS SYSTEMS ENGINEERING

PSE

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The realization of a sustainable transformation system for chemical substances and energies, solely fed with renewable resources, is of paramount importance for the future of our society. For the optimal design of such a system, we need a fundamental understanding of all process levels involved, their hierarchical interaction and the resulting complex system behavior. For this purpose, the group develops new scientific engineering methods, validates their efficacy by use of laboratory scale plants, and provides the know-how for their industrial application.