

PROCESS SYSTEMS ENGINEERING GROUP



Førsteamanuensis
Tore Haug-Warberg



Professor
Heinz Preisig



Førsteamanuensis
Nadi Skjøndal-Bar



Professor
Sigurd Skogestad

- Process modelling
 - Including thermodynamic modelling
- Process optimization and control
- Process simulation and design
- Systems biology



4th year courses

Autumn:

TKP4140* Process control (Prosessregulering)

Spring:

TKP4135 Chemical process systems engineering

TKP4195 System modellering og analyse i Biologi

5th year courses, autumn

TKP4555 PROCESS- SYSTEM ENGINEERING specialization

Select two modules from the following:

- **TKP10** Process Control, Advanced Course
- **TKP11** Advanced Process Simulation
- **TKP12** Thermodynamics, Advanced Course
- **TKP13** Feedback systems in biology

It is also possible to select other modules, but this has to be approved in advance.

- **Examples:**
- **TKPX** Kjemisk prosessteknologi, spesielle emner (distillation)
- **TTK16** Modellprediktiv regulering (MPC) og optimalisering (Institutt for teknisk kybernetikk)
- **TEP9** Termisk kraft/varme - produksjon (Institutt for termisk energi og vannkraft)

TKP10 Process Control, Advanced Course

- **Lecturer:** Professor Sigurd Skogestad
- **Learning outcome :** Be able to design plantwide control system
- **Content:**
 - Control structure design for complete chemical plants.
 - Selection of controlled variables (self-optimizing control).
 - Consistent inventory Control.
 - Regulatory control.
 - Tuning of PID controllers.
 - Multivariable control.
 - Decentralized control.
 - RGA. Introduction to MPC. Use of dynamic simulators.
- **Teaching activities:** Lectures, computer simulation. exercises.
- **Course material:** Copies from scientific papers and books including Chapter 10 in Skoegstad and Postlethwaite, "Multivariable Feedback Control, Wiley, 2010

TKP11 Advanced Process Simulation

- Lecturers: Professor Heinz Preisig (coordinator) and professor Magne Hillestad
- **Contents:** Simulators solve sets of equations representing the behaviour of plants, namely mathematical models for the plant. The topic of the course is to shed some light on what is under the hood of these simulators.
 - The subject is extended by optimisers which are superimposed on the simulators upwards and physical property interfaces downwards.
 - The course touches on the theoretical subjects associated with the methods used in simulators and optimisers, such as graph theory for the representation of networks, sequential modular approaches and simultaneous equation approaches and possibly integrators.
- **Course form:** Lectures, tutorials and project. The course is largely project oriented.
- **Prerequisites:** Course in numerics, optimisation and preferably TKP4135 Chemical Process Systems Engineering
- **Compulsory activities:** exercises, presentations, project work

TKP12 Thermodynamics, Advanced Course

- **Lecturer:** Associate professor Tore Haug-Warberg
- **Content:**
 - Thermodynamic methods (Euler functions and Legendre transformations) with applications to thermodynamic state theory.
 - Systematic derivation of basic equations in canonical state variables.
 - Conservation principles of mass and energy used in the analysis of practical problem solutions connected to phase and reaction equilibria.
 - Introduction to thermodynamic modelling.
 - The course is adapted to individual needs if feasible (more weight on the modelling and less weight on the problem analysis, or vice versa).
- **Teaching activities:** Regular teaching and colloquiums.
- **Course material:** Lecture notes and copies of articles.

TKP13 Feedback systems in biology

- **Lecturer:** Associate Professor Nadi Skjøndal-Bar
- **Aim of the course:** To present the concept of feedback in relation to biological intra- and intercellular processes
- **Prerequisites:** TKP4140 process control or equivalent knowledge in control
- **Module description:** The concept of feedback is well known from control theory, and is quite abundant in biology.
 - Concept of negative and positive feedback inside the cells and in genetic circuits.
 - Cellular response to combinations such as negative-negative, positive-negative feedback structures
 - Oscillations and bi-stability
 - Effect of feedback on the evolution of species.
- **Teaching methods:** Seminars, self study, exercises/project work with presentations.
- **Course material:** Articles and excerpts from textbooks.

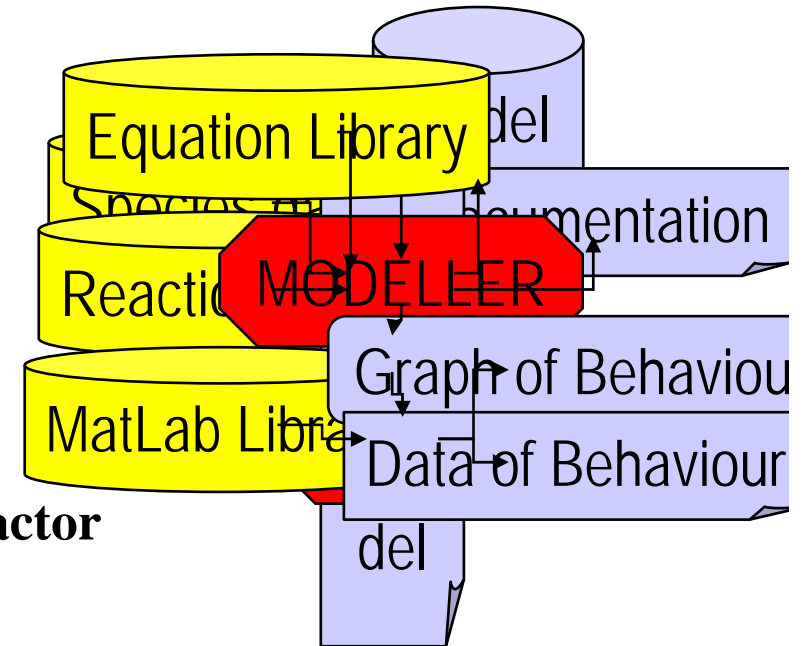
Tore Haug-Warberg

Research projects

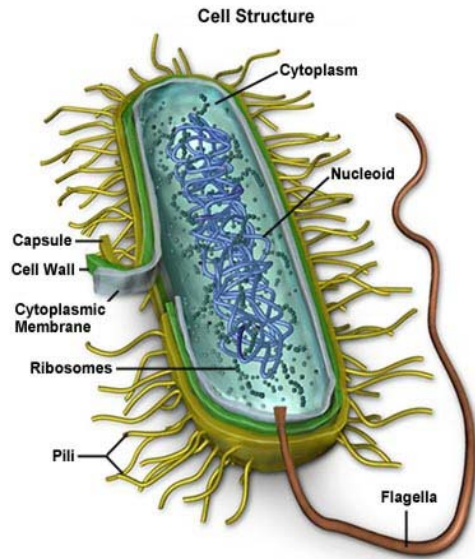
- 1. Thermodynamics of LNG using the GERG equation of state.**
- 1. Taylor-expansion of thermodynamic equilibrium states arising from flash calculations.**

Heinz Preisig

Research projects

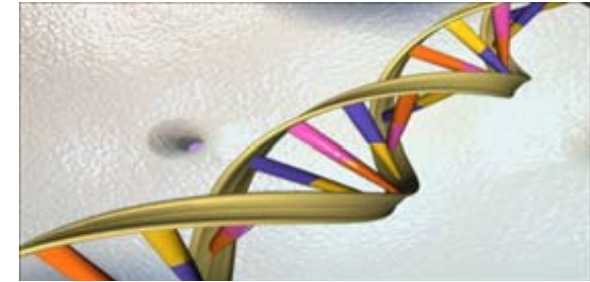


1. **Temperature distribution in milli-reactor**
2. **Continuous distillation**
3. **Colloid chemistry experiment**
4. **Biodynamic experiment**
5. **Membrane experiment**
6. **Chemical Engineering ontology for standard reactor types**
7. **Computer-aided modelling**
8. **Control and Felles lab rejuvenation**
9. **Automatic Safety and Hazard Analysis**
10. **Simple Thermo Server**
11. **On time scaling in chemical processes**
12. **Frequency Analysis of Distillation**
13. **Process Identification using Wavelets**



Nadi Skjøndal-Bar

Research projects



1. Cancer research Network component analysis (NCA)

-The project (and thesis) will be conducted by collaborating with the GastroCenter at St. Olav's hospital.

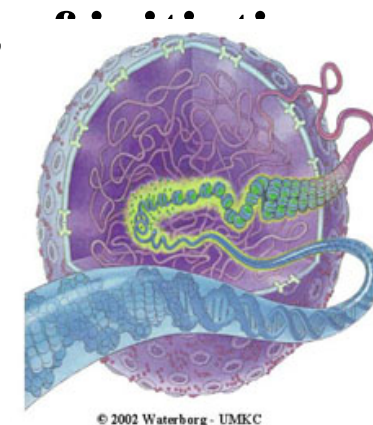
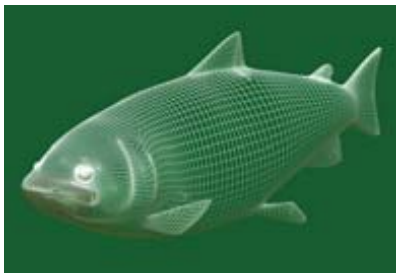
2. Modelling and analysis of the process control in protein synthesis

3. Development of appetite model

4. Digestive system modelling

gene coding and indexing system

modelling of growth of organism



Sigurd Skogestad

Research projects

- Control and optimal operation of CO₂ capturing process
- Optimization of processes using “self-optimizing” variables
- Optimal operation of heat exchanger networks using self-optimizing control
- Dynamic back-off for control of active constraints
- Flexible/optimal steady-state backoff for unconstrained variables to avoid infeasibility
- Stabilization of two-phase flow in risers from reservoirs (anti-slug control) (in cooperation with Siemens)
 - 6.1: Control strategies for gaslift
 - 6.2: Robust anti-slug control strategies.
- Studies on control of distillation columns (in cooperation with Statoil/Gassco at Kårstø)
- Simulation and operation of CO₂ capturing process
- Compressor control (FMC)
- Biofuel production
- **Extra (Perstorp co.): Catalytic combustion control (avoiding explosions)**
 - *See project description on Sigurd’s home page*



Conclusion: Welcome to K4 – 2nd floor!

