We have developed CAD tools to design DNA, RNA and protein nanostructures and devices. The designed sequences are ordered and produced in the lab.

Biomolecular design lab

We use biomolecules as building blocks to design nanoscale devices for applications in basic science and technology. Our research aims at understanding the fundamental principles of how biomolecules fold into unique and functional shapes and at using this insight to guide the design of novel nanoscale devices. The designer molecules are used for reprogramming cell properties to function as e.g. biosensors, enzyme assembly lines or signaling networks.

Approach and method

Computer-aided design
We have developed CAD tools to design DNA, RNA and protein nanostructures and devices. The designed sequences are ordered and produced in the lab.

Structural characterization
We use biophysical characterization techniques such as atomic force microscopy (AFM) and cryo-electron microscopy (cryo-EM) to verify molecular designs.

Synthetic biology applications
Verified molecular designs are genetically encoded and expressed in bacteria or eucaryotic cells and properties are tested with e.g. fluorescence microscopy.

Project examples

Master project:
Control of enzyme activity by switchable RNA scaffolds
In this project Kalinka Hansen designs RNA lattices that assemble when a ligand is present. The RNA lattice will be used to attach an enzyme system that produces the ligand and thus constitute an autoregulatory system in cells.

PhD project:
Biosensors for selection of production strains in nanodroplets
In this project Bente K. Hansen works with Novo Nordisk to develop biosensors for GLP-1 that will be used for selection of yeast production stains in a nanodroplet setup.

Postdoc project:
RNA-protein scaffolds studied by cryo-electron microscopy
In this project Ewan McRae design RNA scaffolds for proteins with the aim of characterizing the atomic structure of RNA-protein complexes that have not been possible to solve the structure of because of flexibility and/or size limitations.

Read more ...

A single-stranded architecture for cotranscriptional folding of RNA nanostructures, Geary et al., Science 2014.
Development of a genetically encodable FRET system using fluorescent RNA aptamers, Jepsen et al., Nature Communications 2018.