Image Analysis and IR Spectroscopy for integral fermentation understanding and control

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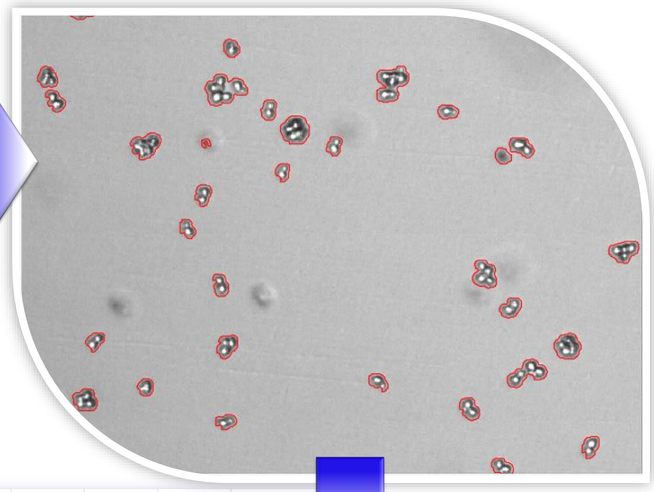
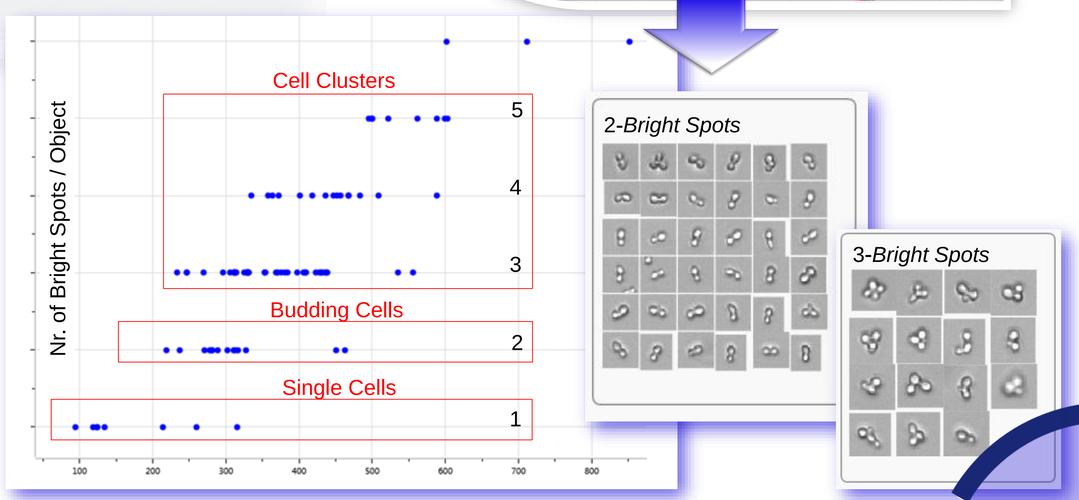
Introduction

Industry is focusing increasingly on the development of **more efficient and less time-consuming methods** to **monitor and control** their **fermentation processes** at optimal conditions. Note that, fermentation processes are often the most complex step within bio-manufacturing. Nevertheless, the detailed understanding of the process is often lacking and control decisions are frequently introduced manually based on experience instead of process data. We want to **assess industrially relevant fermentation processes** with advanced but still rather uncommonly used **cutting-edge technologies** thus developing new monitoring methods while improving the **integral understanding and success** of the process. Aiming at **robust and generic on-line monitoring techniques** the focus of our research lies on a state of the art insulin production process by yeast. Our research comprises **spectroscopy and image analysis** combined with **chemometric modelling** as a promising approach supplementing the future online sensor toolbox.

Image Analysis

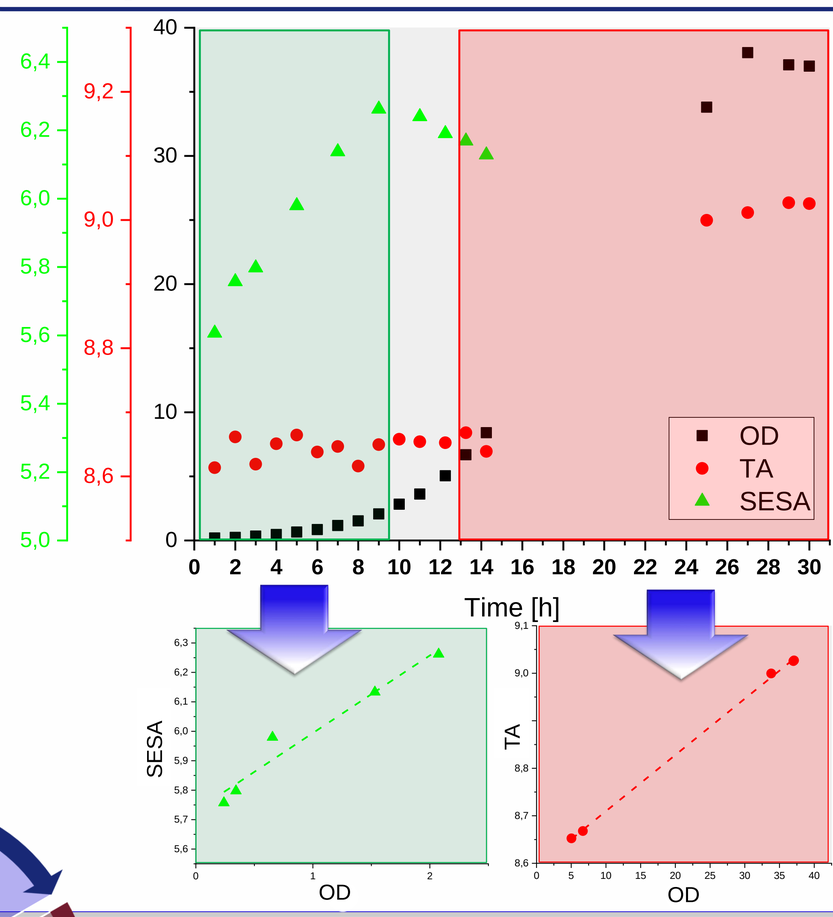
Yeast Segmentation



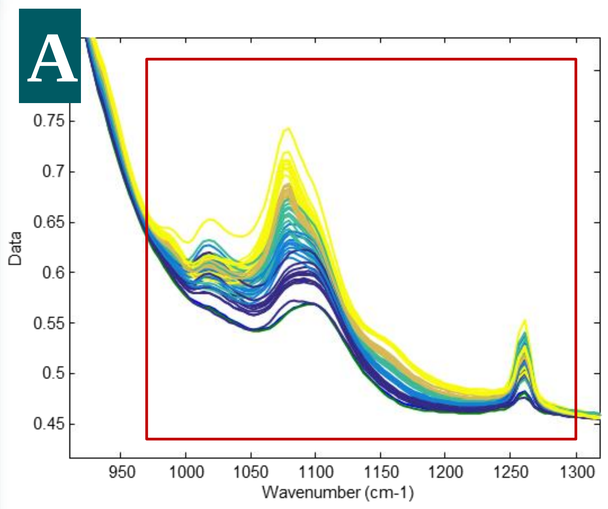


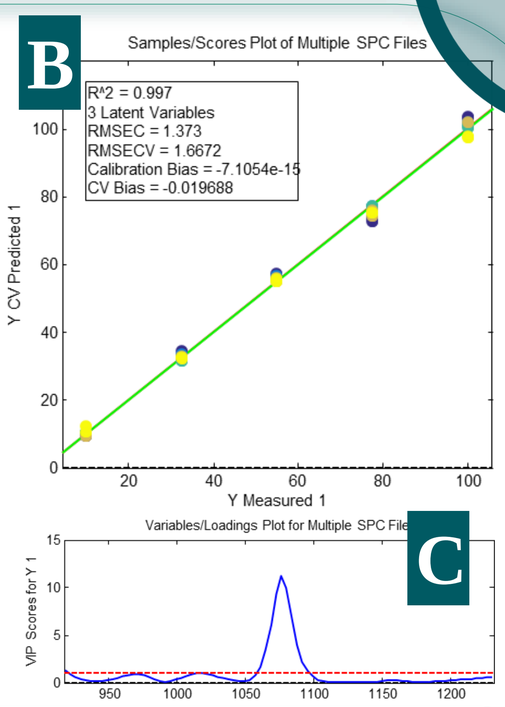
Yeast Growth

SESA algorithm for low OD (< 2.5) and TA algorithm for high OD (>5)
SESA: 'Segmentation and Extraction of Surface Area', TA: 'Total Absorption'



IR Spectroscopy





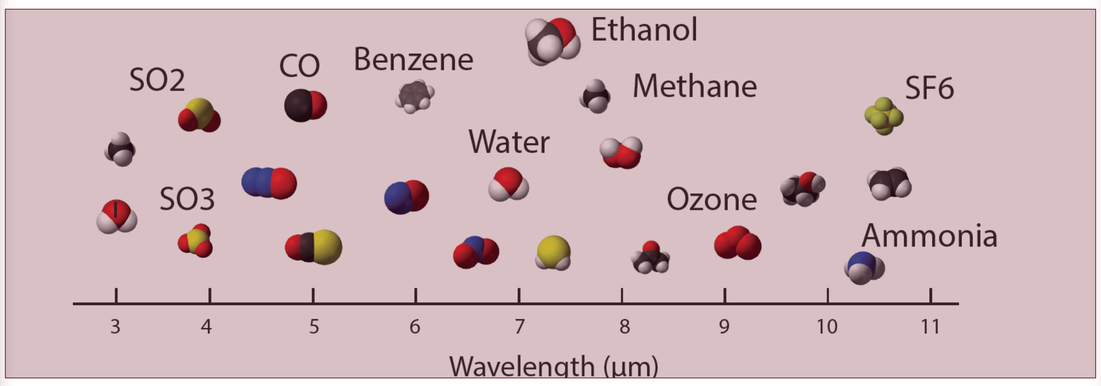
Monitoring of multiple nutrients by IR spectroscopy combined with PLS modelling

A: Example: selected region (variables) of the IR spectrum tied to Phosphate
B: PLS model based on the variables selected and reference concentrations
C: High VIP scores for the variables selected verify high relevance for the model

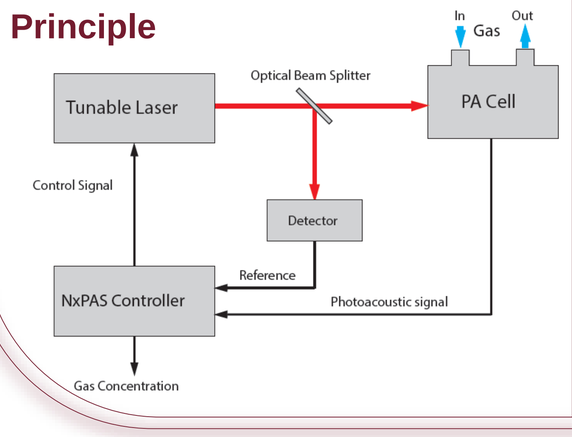
Off-GAS Analysis

Next Generation Photoacoustic Gas Analyzer

Concentration determination achieved through gas IR spectra analysis



Principle



BIOPRO

This PhD project is carried out as a part of BIOPRO and conducted as a collaboration between Copenhagen University (KU Food, spectroscopy), BioSENSE (image analysis), NxPAS (off-gas analysis) and Novo Nordisk.