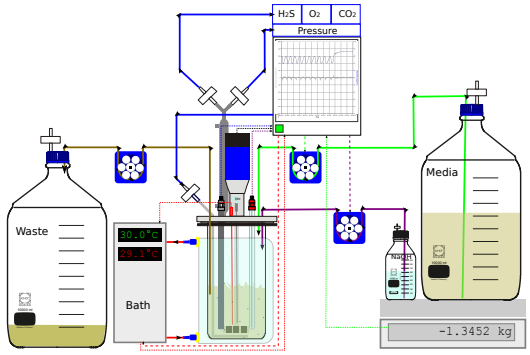
QTB PBR Hack‘a’thing

Soldering for and by beginners.

March 2–4, 2016

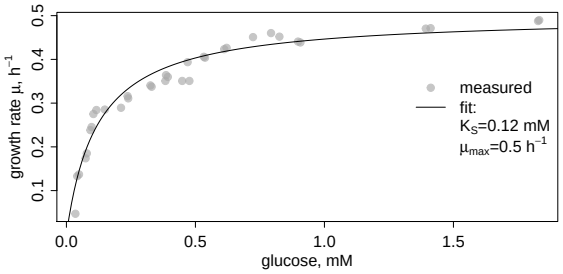
Contents

1 PBR Hack'a'thing Projects



(a) Dougie's Reactor

Monod: $\mu = \mu_{max} \frac{S}{S+K_S}$



(b) Snoep *et al.* 2009

Figure 1: Bioreactors

1.1 Gas Flux: Gasometer

Project: Extend existing setup, co2meter's O2 and CO2 sensors with Sainsmart's Arduino Mega+Touch screen; see directory `offgas/arduino` in `https://git.hhu.de/machne/PSIControl` for Arduino code

1. **code** sensor calibration routines via touch-screen (use PSI gas mixing system)
2. **build** water trap, tubing path from reactor, and casing for sensors and Arduino; **build** improved gassing system (glas blowers!) to allow lower flow
3. **build** & **code** interface to Aalborg XFM digital mass flow meter: connect the Aalborg's RS 485 interface to Arduino hardware serial Tx3,Rx3
4. **build** & **code** valve control to measure several reactors; connect via Arduino software serial connections; perhaps attach to PSI Multicultivator

Materials:

- Existing setup: **available**
- Aalborg XFM, with RS 485 interface: **available**
- Valve system for gas tubing, controllable *via* serial interface: **obtain**

1.2 Liquid Flux: Continuous Culture & Turbidostat

Project: build a module consisting of media and waste bottles, a reactor vessel, peristaltic pump(s), and a balance; pump and balance are controlled *via* serial interfaces from an Arduino+Touchscreen and/or Raspberry Pi. The flow rate is controlled *via* pump and recorded *via* the balance, dilution rate (depends on culture volume) is recorded or can be set.

1. **build** a simple reactor vessel (Schott bottles) with liquid media flow, from media bottles through reactor vessel and out to waste bottle; connect *via* tubing and pumps, record *via* balance
2. Add gassing system of project 1.1
3. Combine with 1.3 to make turbidostatic control

Materials:

- Media bottlesm, screw caps with inlet/outlet openings, and tubing: **available** in the lab, but check!
- Balance (e.g. Mettler Toledo PBK785-3XS/f): **obtain**
- Peristaltic pumps: ordered?
- Arduino: **obtain**

1.3 Light Flux: Spectrometer

Project: Simple spectrometric measuring tool based on AvaSpec-Mini2048l-U25

1. Basic: Connect to Rasperry Pi, using drivers provides by Avantes; **code** simple interface with display and/or recording functions
2. Advanced: use LED for absorbance, reflectance, or fluorescence measurements; **build** light paths and perhaps a reactor probe for online recording

Materials:

- AVASPEC-MINI2048L-V25, Minispectrometer: **available**
- Fiber optic cables, VIS/NIR: 1 m, 200 µm VIS/NIR and 1m, 600 µm: **available**
- Raspberry Pi Version 1: **obtain**
- LED system: use PSI LEDs or **obtain**

- Reactor probe: **build** together with fine mechanics or glas blowers

1.4 Heat Flux: Water Bath Thermostat

Project: build a water bath for growth vessels, control T, read-out energy required for maintaining constant T and estimate the amount of heat withdrawn or administered

1.

Materials:

- Jacketed reactor vessel: **build** or **obtain**
- Julabo water bath, e.g. F25-ME
- Arduino and/or Raspberry Pi

1.5 Single Cell Biology: Microfluidics Device

Project: Basic microfluidics and live-cell imaging device; scratch growth chambers and liquid flow channgels into microscope slide; attach 2–3 pumps; and control *via* arduino/screen

Materials:

- Ilka's lab microscope: **available**
- Microscopy slides: **available**
- 2–3 peristaltic pumps for microfluidics: **obtain**
- Sainsmart's Arduino Mega + Touchscreen: **obtain**

2 Program

2.1 Day 1 <12:00 : Building Bioreactors

Talks, 30-60 min:

2.1.1 Rob's DIY Reactor - The Beginnings

The Captor - Arduino-controlled mini PBR

2.1.2 Dougie's DIY Reactor - 20 yrs Later

2.1.3 Avantes - Spectrometry

Spectrometry applications, incl. NIR for metabolite measurements and OD

Software interface to Avantes spectrometers

2.1.4 CellDeg - Optimizing Photosynthetic Growth

Introduction to CellDeg's 2.5 k Euro algal growth setup (overnight 30 g/L cyano biomass)

2.2 Day 1 >13:00 : Hack'a'thing I

Introduction to the gasometer: connecting sensors with Arduino, making an autonomous measurement device via Sainsmart's Touch Screen

Introduction to Rob's reactor: complete setup for photosynthetic growth

Self-organizing into teams: lab hardware (tubing etc.), control hardware (soldering etc.), software

2.3 Day 2 <12:00 : Photobioreactors in Research

Talks, 30-60 min:

Nir Keren, Hellingwerf, Jan Cerveny, Dougie Murray, something microfluidics?

2.4 Day 2 >13:00 : Hack'a'thing II

Perhaps in teams, either by projects (1.1–1.5) or in software vs. hardware (soldering/tubing) vs. biolab (cell cultures), or – most likely – in dynamic self-organisation, working parallel on all projects.

2.4.1 Hardware I

soldering, tubing

2.4.2 Software I

probe/sensor/pump ⇔ arduino/raspi interfaces

2.5 Day 3 <12:00 : Hack'a'thing III

2.5.1 Hardware II

Integrate projects 1.1,1.3&1.2 into a simple DIY reactor and/or with PSI FMT150 or Multicultivator

Integrate project 1.5 with the simple microscope in Ilka's lab, or a more advanced system (CAi?)

Visit HHU's fine mechanics and glas blower work-shops, place orders for stuff missing for above goals

2.6 Day 3 >13:00 : Consolidating

2.6.1 Software II

arduino/raspi ⇔ master/server interface

Standard data formats and interfaces

Brain storming: relation of data and models

Beer: relation of data and models and beer