Overview of *IndPenSim*

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This document presents an overview of *IndPenSim*, a first principles mathematical simulation of an industrial-scale fed-batch penicillin fermentation. A summary of the main Matlab files implemented in the simulation is given, including html links to the M-files. Specific details regarding the simulation can be found in the paper titled "The Development of an Industrial-scale Fed-batch Fermentation Simulation" (available in the Journal of Biotechnology).

1 INPUTS AND OUTPUTS

The simulation was developed using the batch data recorded on a 100,000 litre penicillin fermentation process. The industrial data is available to download and contains all the main inputs and outputs. A summary of the main inputs and outputs of the simulation is summarised in Fig. 1. All the variables highlighted in blue represent the variables that were recorded by the batch records. The variables in black represent those that were approximated by the simulation.
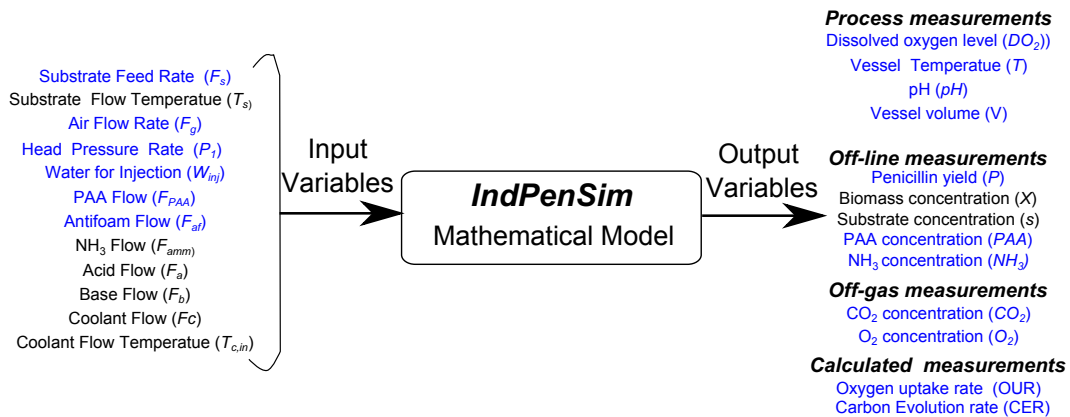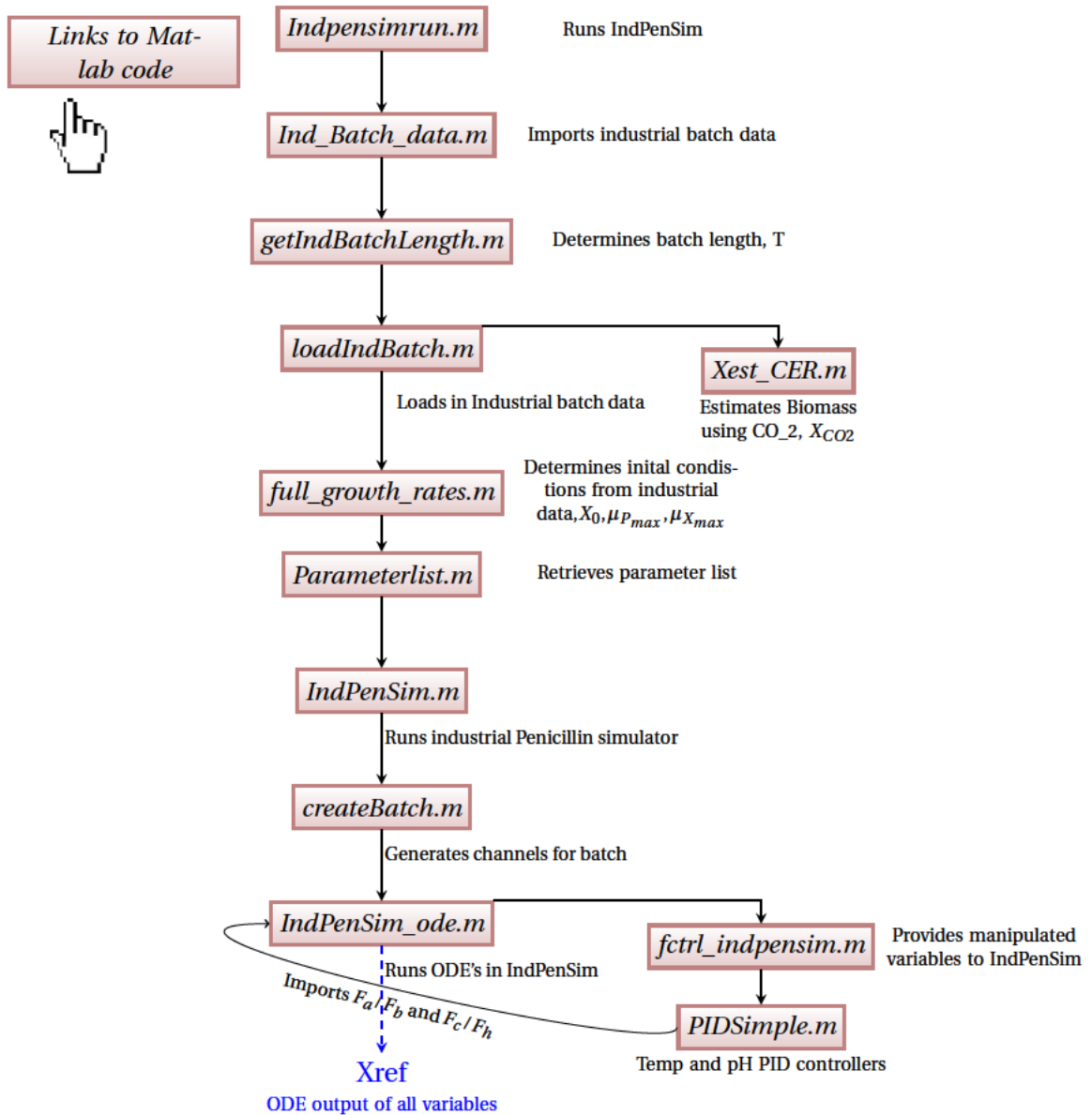

Figure 1: Summary of main process inputs and outputs considered by *IndPenSim*.

2 OVERVIEW OF *IndPenSim*

A flow chart illustrating the main Matlab files implemented by *IndPenSim* is presented below. A detailed description of each M-file is available in the comments of each file. The files can be viewed by clicking on the html links provided.

Overview of *IndPenSim* Matlab files

Links to Matlab code	
Indpensimrun.m	Runs IndPenSim
Ind_Batch_data.m	Imports industrial batch data
getIndBatchLength.m	Determines batch length, T
loadIndBatch.m	Loads in Industrial batch data
Xest_CER.m	Estimates Biomass using CO_2, X_{CO2}
full_growth_rates.m	Determines inital conditions from industrial data, $X_0, \mu_{P_{max}}, \mu_{X_{max}}$
Parameterlist.m	Retrieves parameter list
IndPenSim.m	Runs industrial Penicillin simulator
createBatch.m	Generates channels for batch
IndPenSim_ode.m	Runs ODE's in IndPenSim
fctrl_indpensim.m	Provides manipulated variables to IndPenSim
PIDSimple.m	Temp and pH PID controllers

Imports F_a/F_b and F_c/F_h

Xref
ODE output of all variables

3 COPYRIGHT NOTICE

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REFERENCES

[1] Stephen Goldrick, Andrei Ştefan, David Lovett, Gary Montague and Barry Lennox *Development of an industrial-scale fed-batch fermentation simulation*, Journal of Biotechnology, 2014.