The Repressilator

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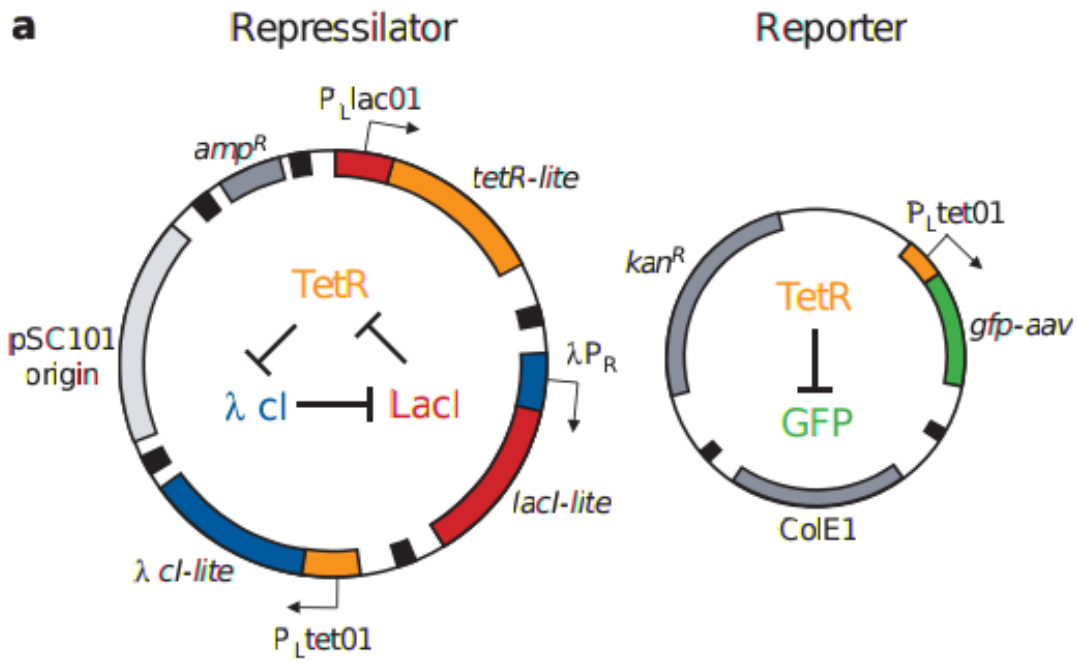
- The design and construction of a synthetic network with oscillatory behaviour.
- Added to e-coli in order to observe whether oscillatory effects would occur.
- Result: Noisy behaviour, but indeed – oscillations.

Design

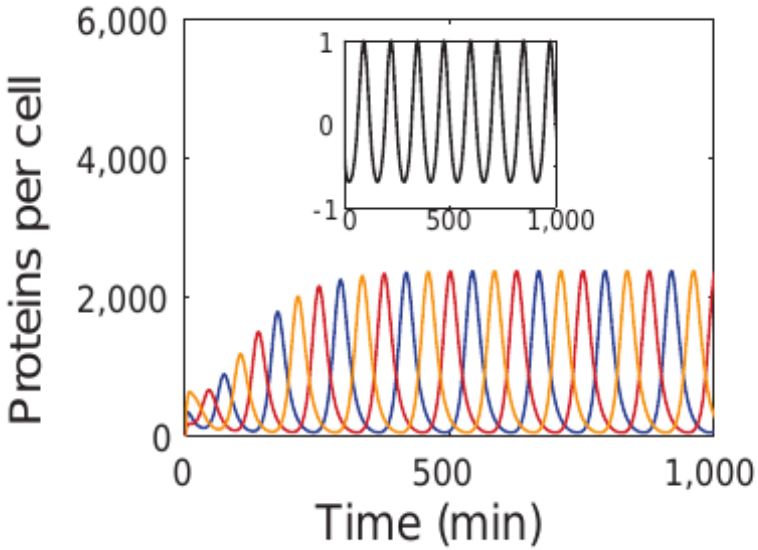

a
Repressilator
Reporter
P L lac01
amp R
tetR-lite
TetR
pSC101
origin
λ cI
LacI
λP R
lacI-lite
λ cI-lite
P L tet01
kan R
P L tet01
TetR
gfp-aav
GFP
ColE1

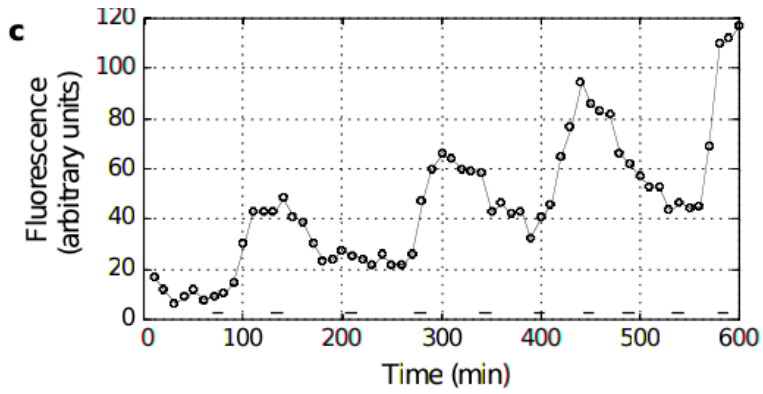
Design

$$\frac{dm_i}{dt} = -m_i + \frac{\alpha}{(1+p_j^n)} + \alpha_0 \qquad \begin{pmatrix} i = lacI, tetR, cI \\ j = cI, lacI, tetR \end{pmatrix}$$

$$\frac{dp_i}{dt} = -\beta(p_i - m_i)$$

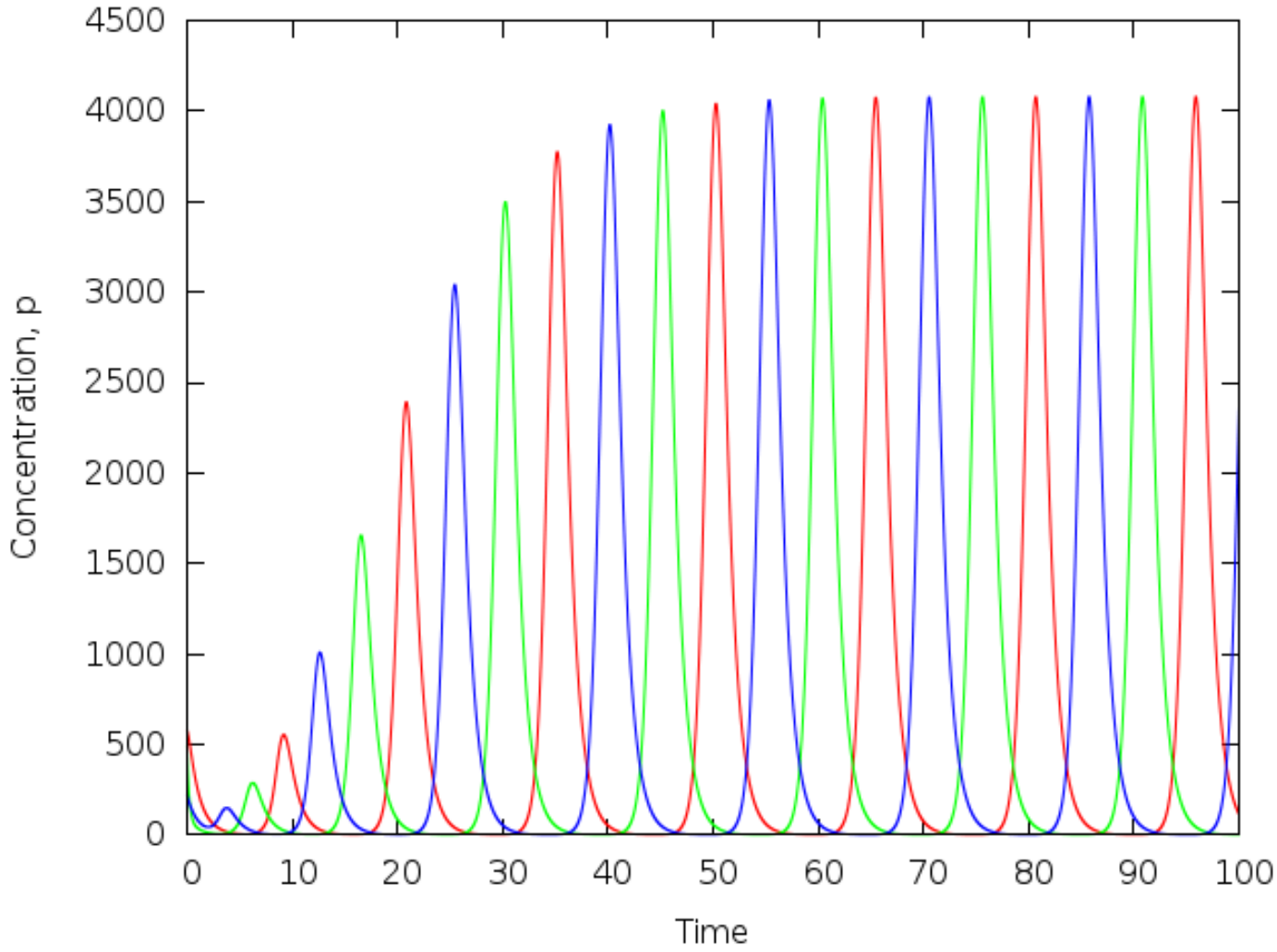
Results


6,000
4,000
2,000
0
Proteins per cell
0
500
1,000
Time (min)
1
0
-1
0
500
1,000


c
120
100
80
60
40
20
0
Fluorescence
(arbitrary units)
0
100
200
300
400
500
600
Time (min)

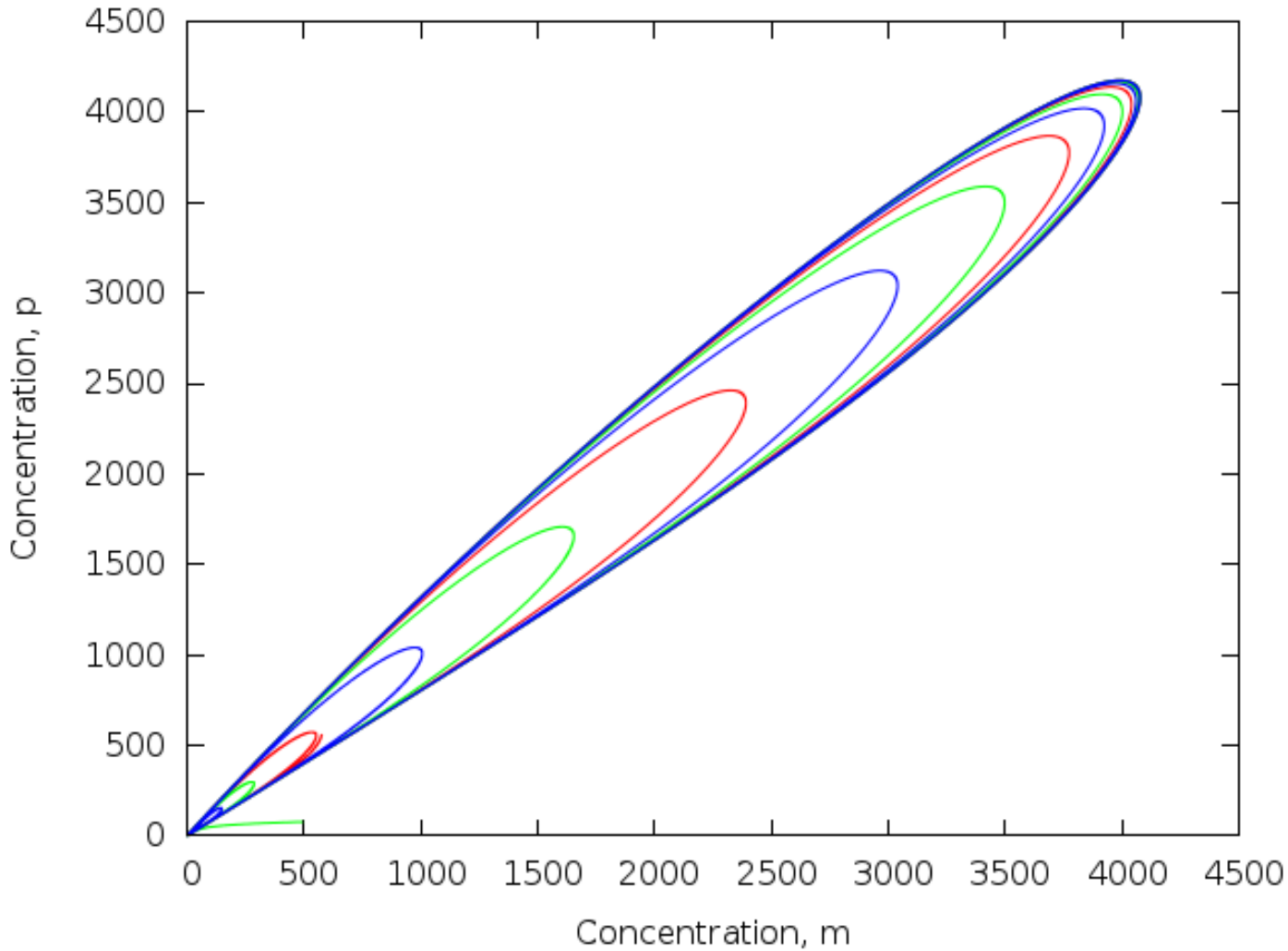
Results

- Stable oscillations



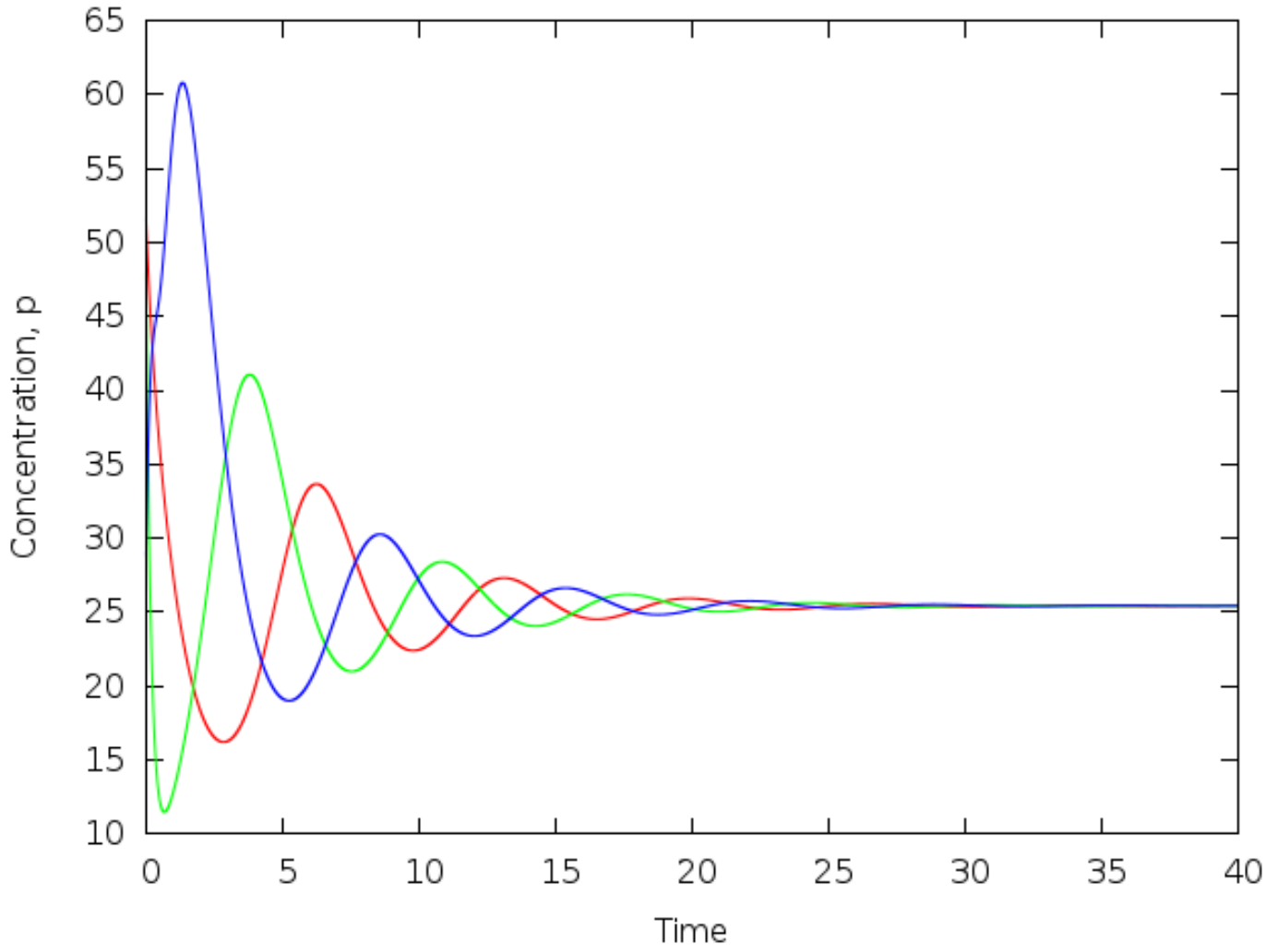
Results

- Repressor-expressor convergence towards cyclic state



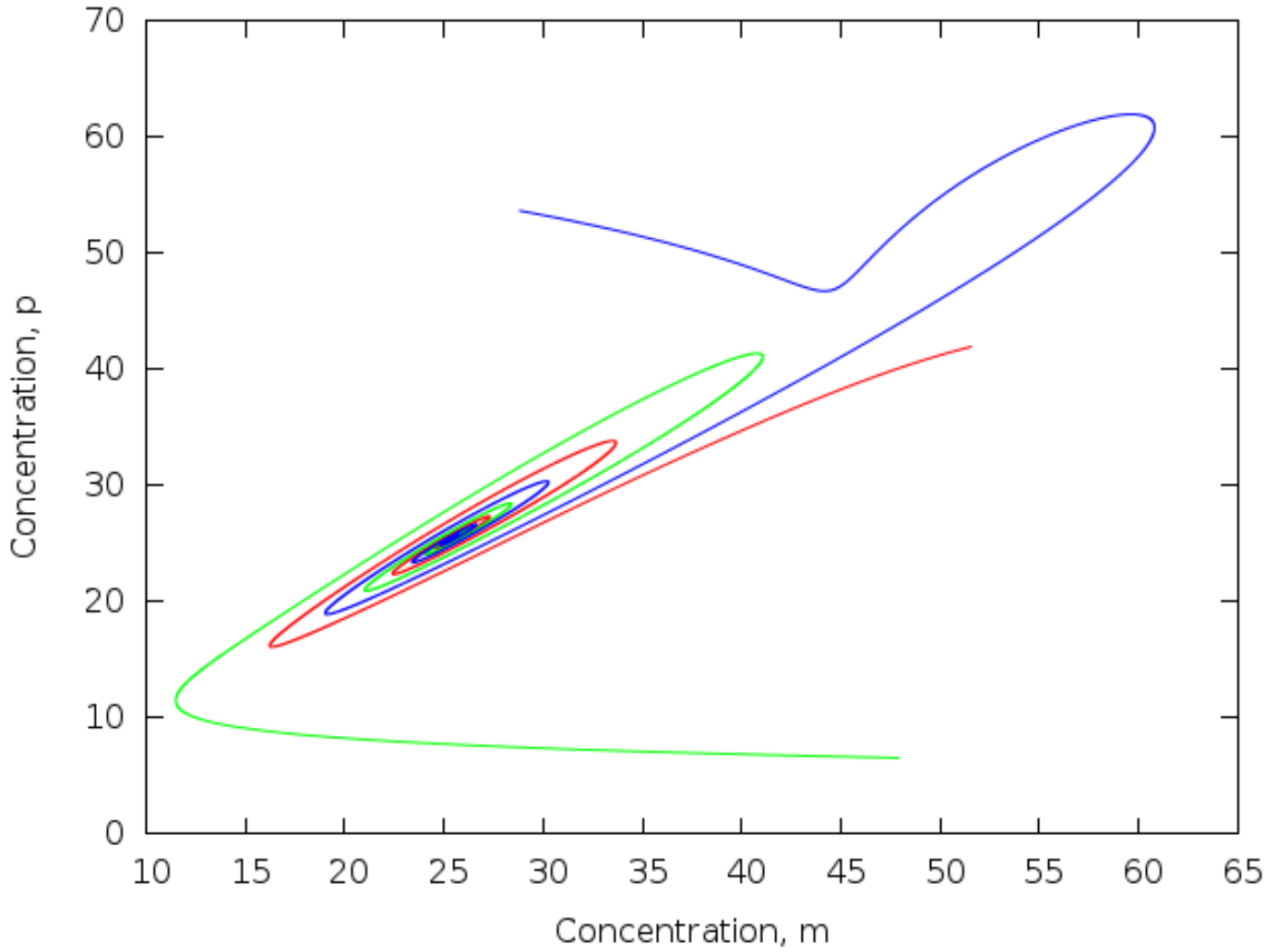
Results

- Non-oscillating convergence



Results

- Repressor-expressor convergence towards "flat" state.



Code

- Implemented in Java
- Fourth order Runge-Kutta