

## Supplementary Material

### The Self-Construction and -Repair of a Foraging Organism by Explicitly Specified Development from a Single Cell

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#### Parameter values

##### Thresholds

In our simulation we used the following thresholds for the values in the above table:

$\eta$	1.0	$\widehat{b}_S$	0.3
$\widehat{b}_0$	0.8	$\widehat{m}$	3.5
$\widehat{c}$	10.5	$\widehat{s}$	3.5
$\widehat{b}_M$	0.3	$\theta$	1.8

##### Diffusion coefficients

Morphogen	Membrane	Environment	Morphogen	Membrane	Environment
$\mathfrak{B}_0$	0.0	0.0	$g_1^C$	0.025	0.10
$\mathfrak{C}$	0.0	0.0	$g_2^C$	0.025	0.10
$\mathfrak{B}_M$	0.0	0.0	$s_1^C$	0.600	0.85
$\mathfrak{B}_S$	0.0	0.0	$s_2^C$	0.600	0.85
$\mathfrak{M}$	0.0	0.0	$g_1^M$	0.030	0.08
$\mathfrak{S}$	0.0	0.0	$g_2^M$	0.030	0.08
$b_0$	0.8	0.7	$s_1^M$	0.550	0.65
$c$	0.8	0.7	$s_2^M$	0.550	0.65
$b_M$	0.8	0.7	$g_1^S$	0.030	0.08
$b_S$	0.8	0.7	$g_2^S$	0.030	0.08
$m$	0.8	0.7	$s_1^S$	0.550	0.65
$s$	0.8	0.7	$s_2^S$	0.550	0.65

The diffusion coefficients for all morphogens used in the simulation. The Membrane column specifies the diffusion coefficients of the morphogen through the cell membrane into the local environment. The Environment column specifies the diffusion coefficient on the lattice of the local environment.

**AxisReactor cell type C:**  $c = 0.13$ ,  $\gamma = 0.05$ ,  $a = 1$ ,  $\alpha = 0.02$

**AxisReactor cell type  $M$ :**  $c = 0.13, \gamma = 0.1, a = 1, \alpha = 0.02$

**InterAxisReactor cell type  $S$ :**  $c = 0.13, \gamma = 0.1, a = 1, \alpha = 0.02, \delta = 0.6$

**SourceReactor** The rates  $r$  for the SourceReactors are the same for all cell types:

$$r = 0.2$$

**ConstReactor** The gain  $\alpha$  for the ConstReactors are the same for all cell types:  $\alpha =$

$$0.1$$

**MigrateCompetence** See section MigrateCompetence for a description of the parameters:  $\epsilon = 4, \lambda = 50$ .

The part of the cell's free energy function depending on the chemical configuration is determined by the following formula:

$$J_p(\mathbf{c}_r) = 30 \cdot \langle \mathbf{c}_r, \mathbf{c}_a \rangle,$$

where  $\mathbf{c}_r$  is the the chemical configuration at node  $\mathbf{r}$ ,  $\langle \cdot, \cdot \rangle$  is the inner product and  $\mathbf{c}_a$  is a vector containing the affinities to the specific chemicals,  $\mathbf{c}_a$  contains +1 and -1 depending on the cells preference to be attracted or repulsed by the corresponding chemical. This is specified in the Description code.

The temperature for the MigrateCompetences is 5. The temperature for the AxonCompetence is 0.1.