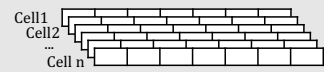


Initialization of cell population

Each cell is stored as a 7-integer array in a monodimensional vector (cell population vector). The integers represent the cell attributes as follows:

Clone ID	CellCycle Length	CellCycle Timer	position (x)	position (y)	position (z)	Proliferating
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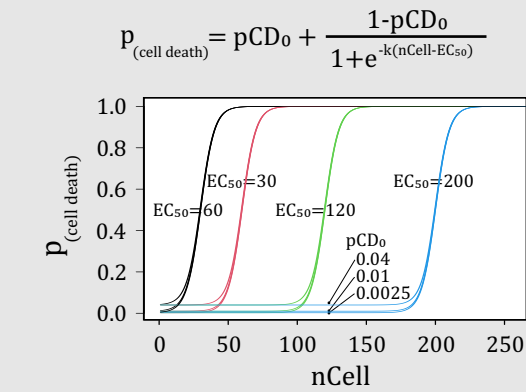
- Clone ID:** a unique identifier for the cell's lineage.
- Cell cycle length:** the current cycle length of the cell.
- Cell cycle timer:** remaining time before the next cell division.
- Position (x, y, z):** the 3D coordinates of the cell in the simulated space.
- Proliferating:** whether the cells is proliferating (1) or resting (0)

Density map computation

A cell-density map is computed by tessellating the continuous space in a 3D-grid and by tallying the number of cells from each lineage within every voxel. This map is subsequently employed to calculate the survival probability of each cell in the following step.

Cell Survival and movement

For any given cell **Q**, death probability is modelled as:

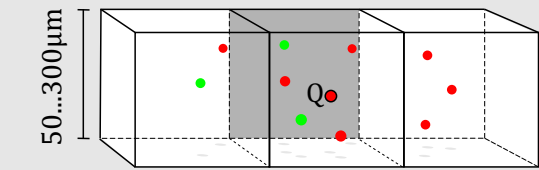


where  $pCD_0$  is the basal cell death probability and  $k=0.2$ .  $EC_{50}$  was one of the explored parameters.  $nCell$  is the number of cells in the voxel occupied by **Q** and is calculated as:

$$nCell = nLCell \times Lw + nACell \times Aw.$$

**nLCell** is the number of cell in the voxel belonging to the same clone of **Q** (lineage cells).

**nACell** is the number of cell in the voxel belonging to other clones than that of **Q** (alien cells).



$$nCell = 4 \times Lw + 2 \times Aw$$

$Lw$  and  $Aw$  are respectively the weight of lineage and alien cells. When clonal competition is not implemented  $Lw=Aw=1$

Replication

Each newborn cell inherits attributes form its mother cell. Some attributes may undergo changes depending from simulation parameters. Cell cycle lenght changes by a Gaussian value. If the variation is negative, it is scaled to prevent cell cycle length to shorten below `LOW_CYCLE_LIMIT` parameter. This mechanism allows for a balance between lineage-specific cycle lengths, introducing fluctuations while ensuring no unrealistically short cycle durations. If the parameter governing the Gaussian variation (`SD_DELTA_CYCLE`) is set to 0, it leads to fixed cell cycle lengths within each lineage.