

ODE model of the female menstrual cycle

How to run an simulation

1. make sure that all files are available
 - InitialValues.txt
 - Parameter.dat
 - StartTimesPoiss.txt
 - FSH.txt
2. set specifications in HumanSimulationFollGrowth.m
 - number of simulation runs
 - specify save options
 - selected type of simulation
 - normal cycle
 - treatment protocol
 - stimulation during the late follicular phase
 - stimulation during the luteal phase
3. run!

HumanSimulationFollGrowth.m

- needed: 'Parameter.dat', 'InitialValues.txt'
- set **specifications for simulation**
 - **ShowStuff** = 1: show plots
 - **runnumb**: set number of simulation runs
 - **SaveStuff** = 1: save data as CSV
 - **DirStuff** : choose directory for CSV
 - simulation options
 - **NorCycle** = 1
 - run without drug treatment
 - **LutStim** = 1
 - luteal stimulation protocol from Kuang et al. (2014b)
 - **LateFollPhase** = 1
 - stimulation in the late follicular phase protocol from Zhu and Fu (2019)
- parameter vectors

para

para(1)	ODE function called to test(0) or not (1)
para(2)	number of equations not related to the follicular maturation <ul style="list-style-type: none">- number is higher than the number of used equations
para(7)	mean FSH sensitivity
para(8)	standard deviation FSH sensitivity
para(9)	threshold LH concentration for ovulation

para(10)	lifetime of follicle after reaching the maximal size
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paraOde: parameter for growth equation

v	fractal dimensio
gamma	growth rate
xi	maximal follicular diameter
mu	proportion of self-harm
k	strength of competition
rho	rate of decline
Folmax	min. follicular size for ovulation

paraPoi: follicle start points follow Poissan distribution

lambda	number of follicles per days
intervallPoi	intervall per day in which follicles appear

CreateLoadFolTimes.m: creates time points for follicle appearance and FSH sensitivity for each follicle

- total number of follicles set to 1000

Simulation_X.m:

- calls ODE solve
- checks the state and growth behaviour of all follicles and evaluate the state
- there are several versions of the function - one for each simulation type (normal Cycle or with drug administration)
- **Tovu:** time point of the last ovulation
 - 14 at the beginning of the simulation, in order to start the simulation -> will be set after each ovulation
- **Follicles:** class in which all follicles and their properties (start point, destiny, growth behaviour) are saved

destiny of follicles

1	ovulation
-1	growing
-2	decreasing
3	bin enough but not ovulated due to low LH level

- integration time is from one follicle appearance to the next one
- **options**: integration stops whenever a follicle ovulates
- **dosing_timeldx**: find the count of the current dosing event
- **dosing_events**: vector that includes the time point of the dosing event and the number of the administration
 - if more than one drug is administered than there is more than one dosing_events vector
- output
 - **FollOvullInfo**: [number of follicle; starttime; time of ovulation; lifetime]
 - **solutions**
 - **CycleInfo**: [[0 Cyclelength]; [rest FollperCycle]; OvuT]

ODE_Model_X.m:

- function includes all ODEs

testfun_X:

- calculation of the follicles' growth and decline
- calculation of E2 and P4
- includes also the calculation of drug concentrations