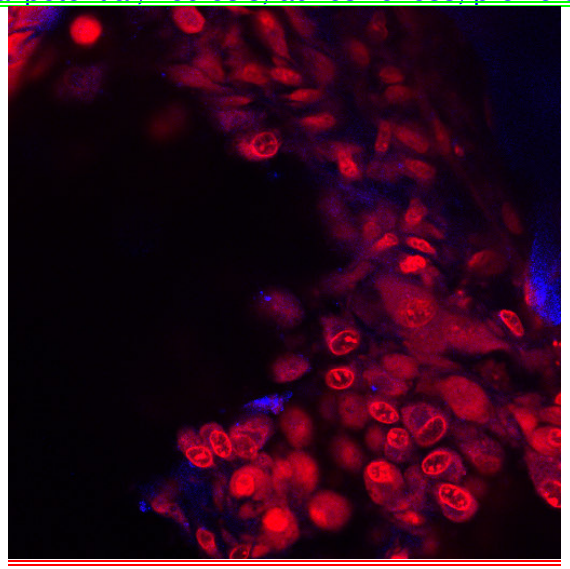
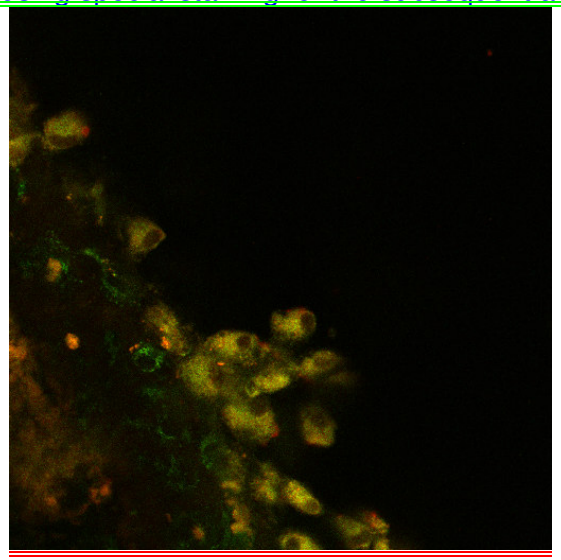
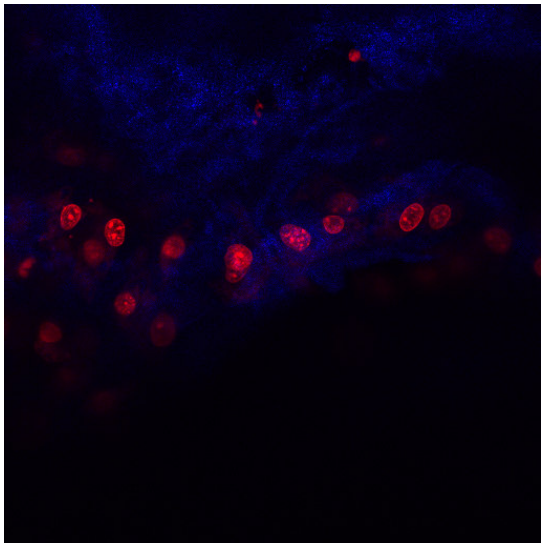
BioDevice systems

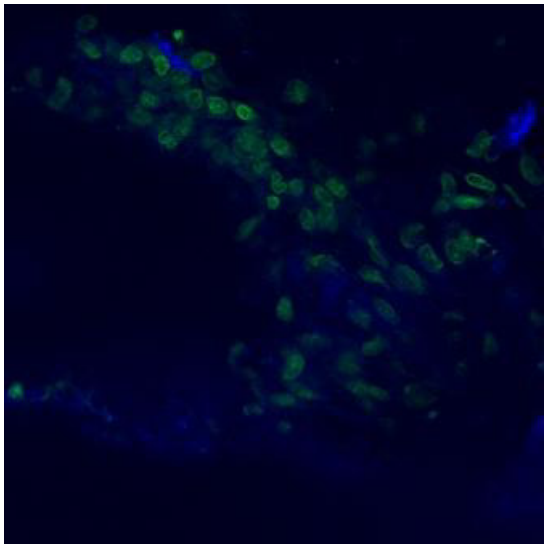
For obtaining initial data we realize registration of different cell-tissue parameters in different kind of scaffold (porous and polymeric) using high-resolution methods like SEM, LSM etc.

In particular Laser Scanning Microscopy (LSM) gives possibility to obtain information from different layers of scaffold and characterize cell parameters (viability, apoptosis, mitochondrial potential, necrosis, adhesiveness, proliferation etc.) using special staining for the subsequent analysis (see next pages)

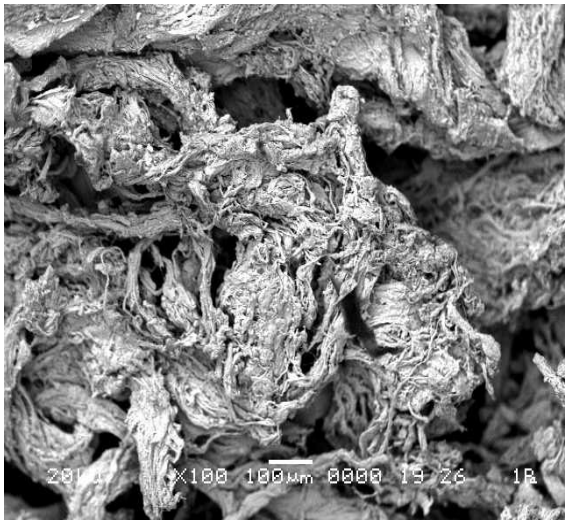


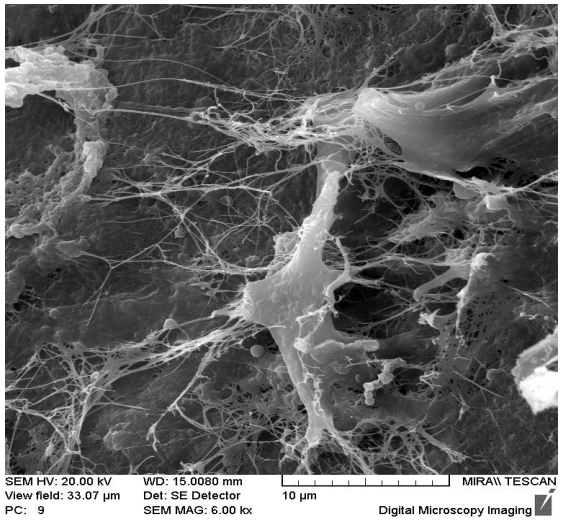


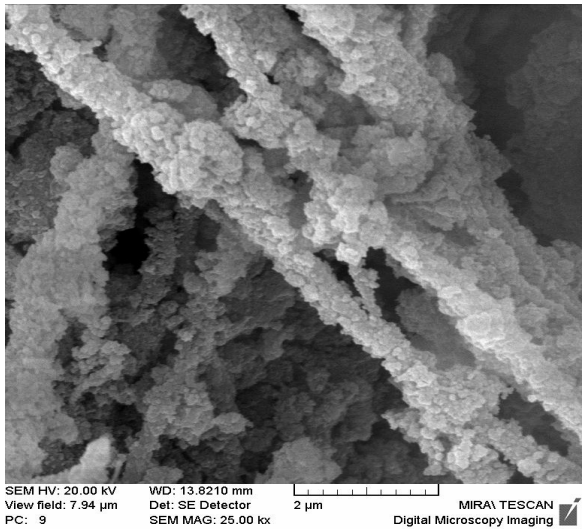


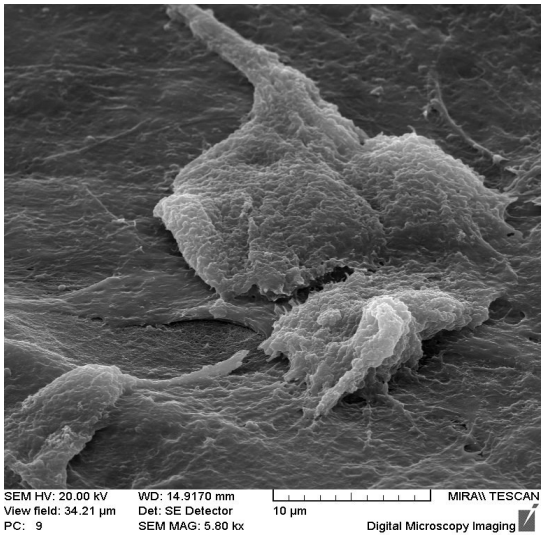


Using Scanning Electron Microscopy we obtain possibility to characterize surface structure and features of cell growth on the scaffolds

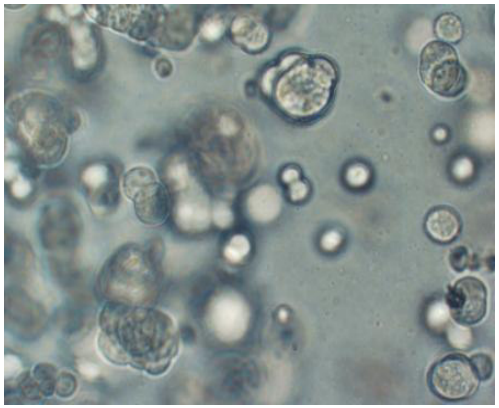


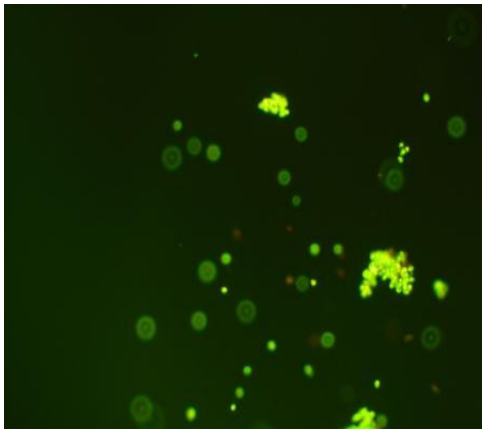


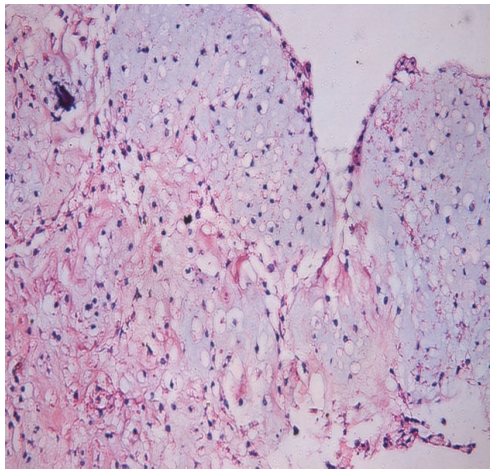




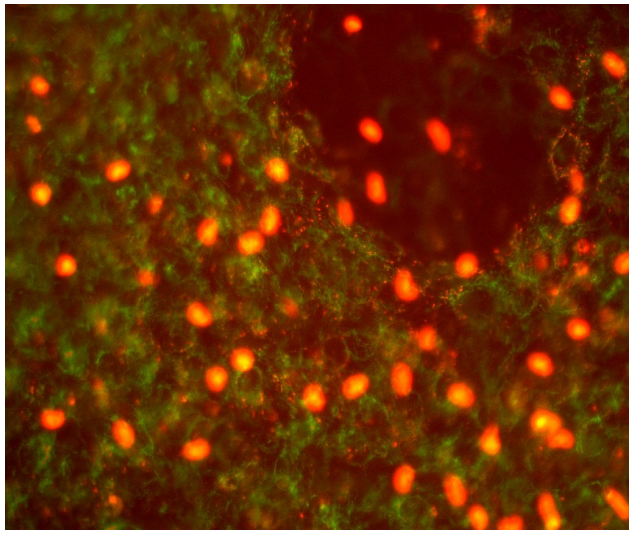
Transparency of some polymeric scaffolds gives possibility to investigate cell development (for example, chondrocyte development into alginate/polypeptide matrix)

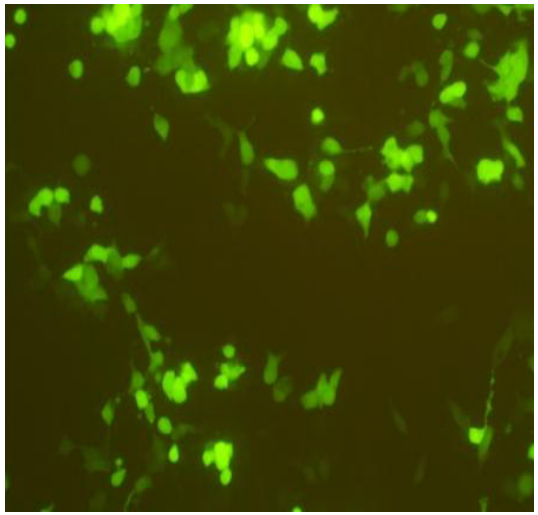


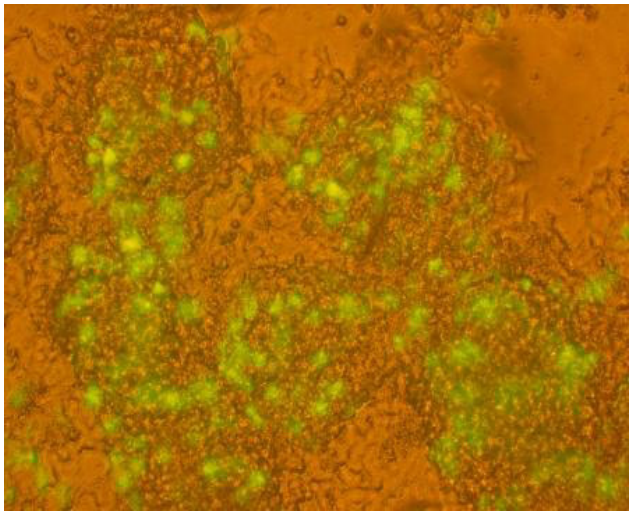


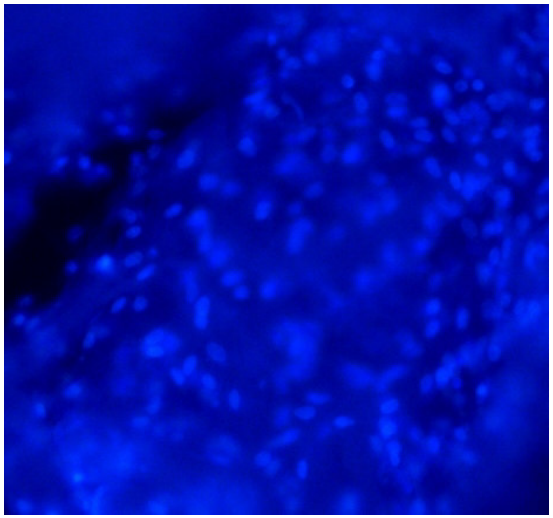


The use of transfection methods and nuclei staining with PI, DAPI etc. gives possibility to trace cell behavior and tissue development.







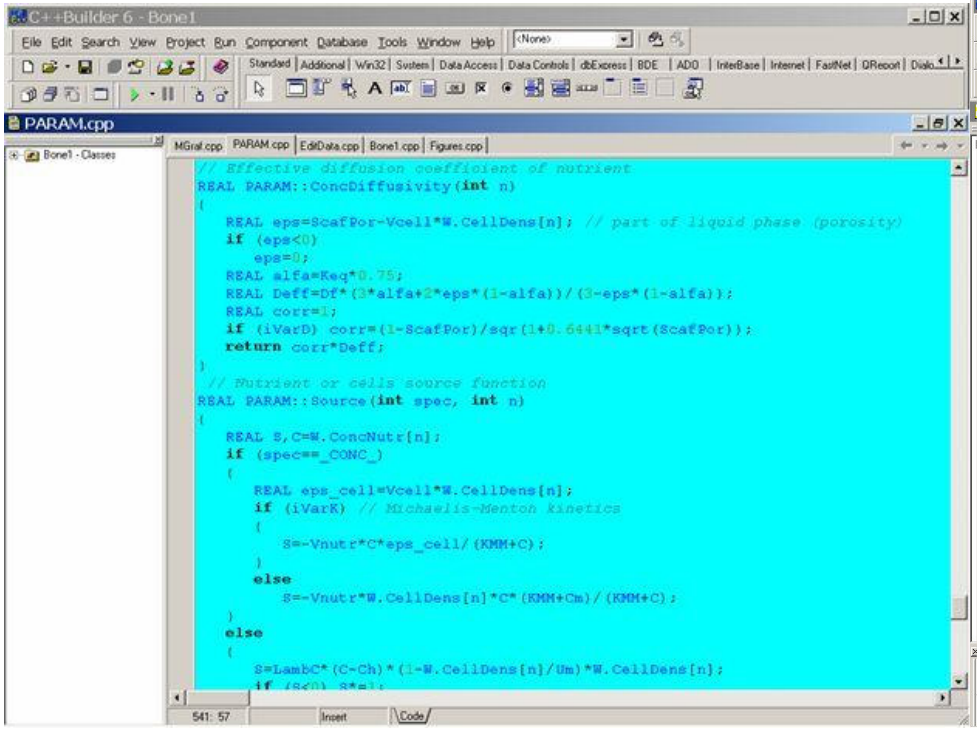


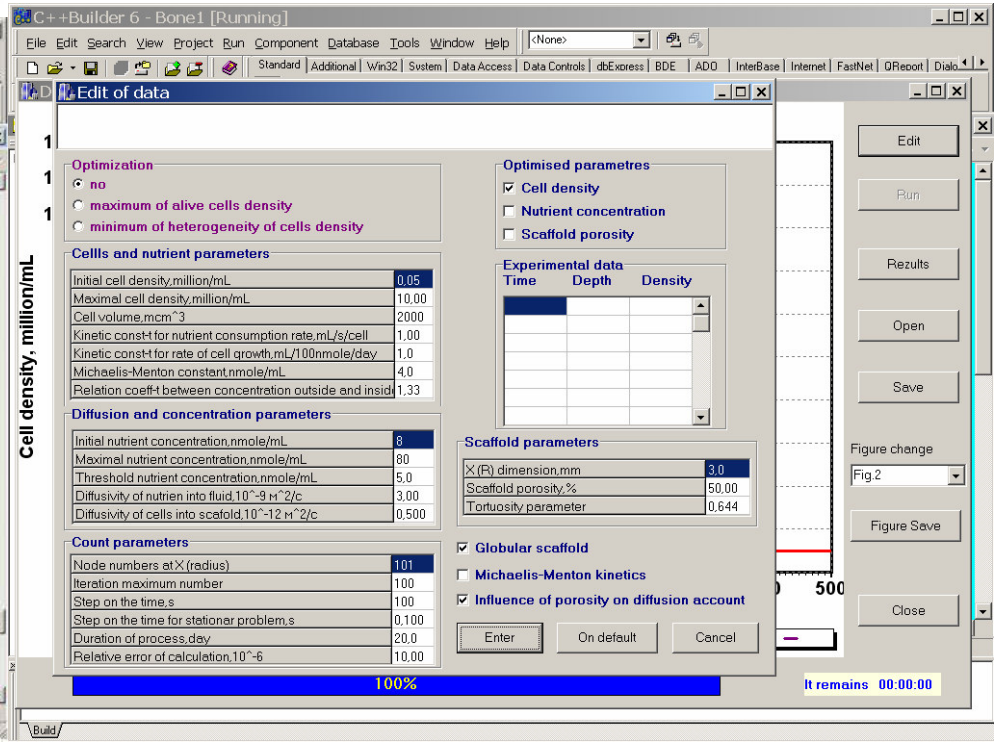
Programm version: 1
Comments:
X (R) dimension,mm: 3
Y dimension,mm: 3
Z dimension,mm: 3
Scaffold porosity,%: 50
Tortuosity parameter: 0.644
Scaffold permeability,m^2: 0
Filtration rate, mL/min: 0
Node numbers at X (radius): 101
Node numbers at Y (depth): 101
Node numbers at Z (gigh): 101
Iteration maximum number: 100
Step on the time,s: 100
Step on the time for stationar problem,s: 0.1
Duration of process,day: 20
Relative error of calculation,10^-6: 10
Variant: 1
Scaffold form (1-sphere, 3-cuboid): 1
Nutrient: 0-oxygen, 1-glucose: 0
Variant of proliferation modeling (1-Michaelis-Menton kinetics): 0
Variant of diffusion modeling (0-without porosity): 1
Initial cell density,million/mL: 0.05
Maximal cell density,million/mL: 10
Cell volume,mcm^3: 2000
Kinetic const-t for nutrient consumption rate,mL/s/cell: 1
Kinetic const-t for rate of cell growth,mL/100nmole/day: 1
Michaelis-Menton constant,nmole/mL: 4
Relation coeff-t between concentration outside and inside of cell:
1.33
Initial nutrient concentration,nmole/mL: 8
Maximal nutrient concentration,nmole/mL: 80
Threshold nutrient concentration,nmole/mL: 5
Diffusivity of nutrien into fluid,10^-9 м^2/c: 3
Diffusivity of cells into scafold,10^-12 м^2/c: 0.5
Optimization characteristic: 0
Cell density optimization: 1
Nutrient concentration optimization: 0

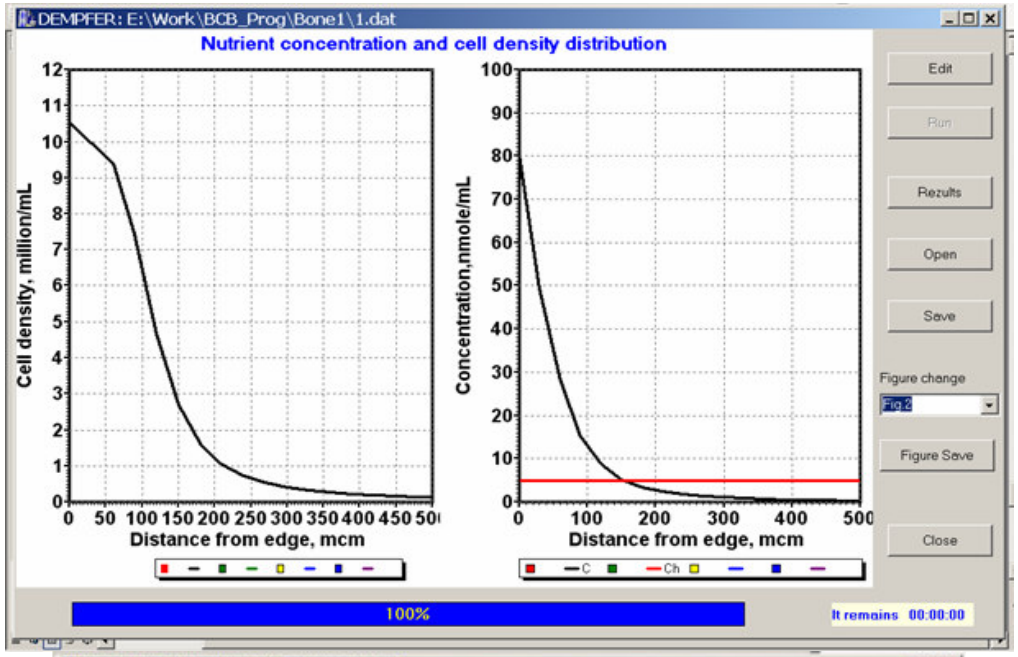
Experimental points number: 0

n	h,мкм	C,нмоль/мл	U,млн кл/мл
100	-0.0	80	10.6992
99	30.0	47.6851	10.243
98	60.0	24.9168	9.78688
97	90.0	10.7874	9.31935
96	120.0	3.70736	8.84242
95	150.0	1.07313	8.36209
94	180.0	0.293953	7.8836
93	210.0	0.0811818	7.41075
92	240.0	0.0230887	6.94652
91	270.0	0.00680605	6.49339
90	300.0	0.00208396	6.05345
89	330.0	0.000663404	5.62847
88	360.0	0.000219663	5.21988
87	390.0	7.56717e-05	4.82884
86	420.0	2.71232e-05	4.4562
85	450.0	1.01149e-05	4.10255
84	480.0	3.92387e-06	3.76823
83	510.0	1.583e-06	3.45339
82	540.0	6.63879e-07	3.15794
81	570.0	2.89283e-07	2.88166
80	600.0	1.30896e-07	2.62414
79	630.0	6.14627e-08	2.38489
78	660.0	2.9926e-08	2.16329
77	690.0	1.50967e-08	1.95864
76	720.0	7.8837e-09	1.77018
75	750.0	4.25779e-09	1.59712
74	780.0	2.37585e-09	1.43861
73	810.0	1.36832e-09	1.29382
72	840.0	8.12521e-10	1.16188
71	870.0	4.96922e-10	1.04194
70	900.0	3.12659e-10	0.933169
69	930.0	2.02161e-10	0.834752
68	960.0	1.34178e-10	0.745899
67	990.0	9.13117e-11	0.665853
66	1020.0	6.36423e-11	0.593889

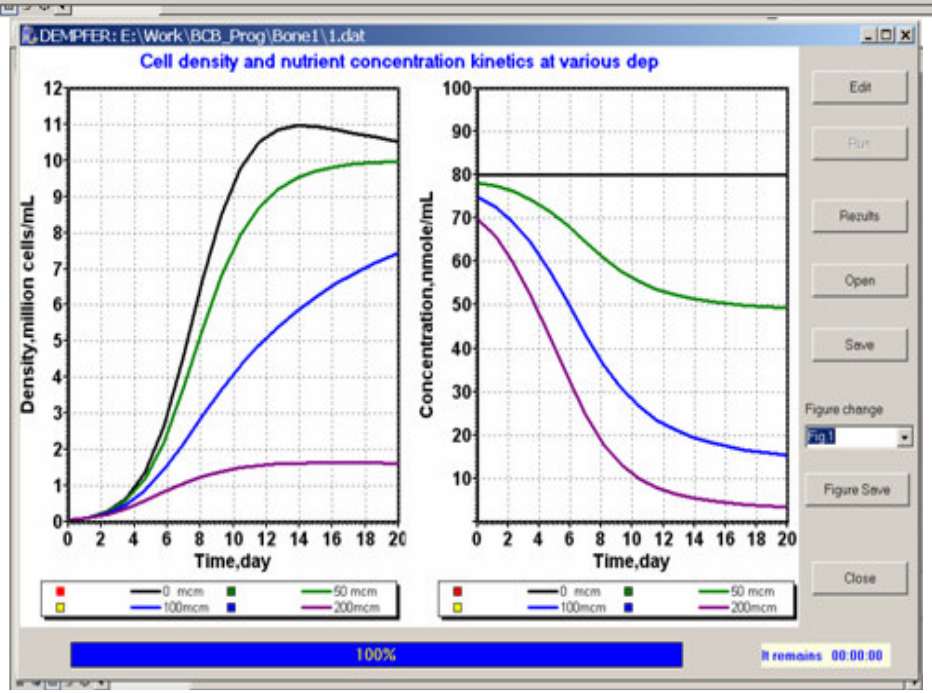
Scaffold permeability properties are rather essential for nutrients and O2 transfer hence maintenance of adequate cell viability. These properties are dependent on material and inner organization of the scaffold and are essential for the following vascularisation..

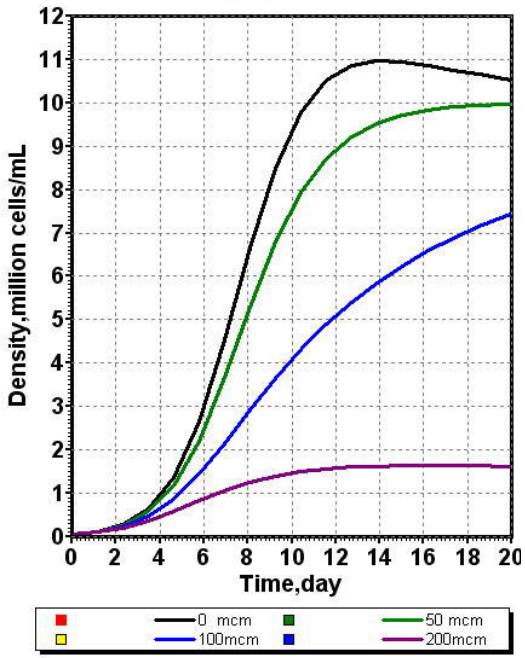


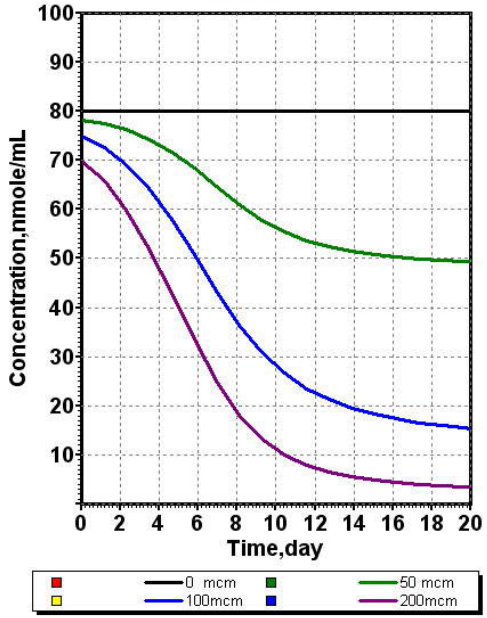




The model of “in vitro nutrient transfer” gives possibility to define quantitative estimations of optimal cell density and distribution on different stages and cell/tissue development inside scaffold.







One of aim is to introduce a new method of computer simulation, reconstruction and visualization of 3-D structure of biological tissues. It includes the high-resolution scanning, computer recognition, reconstruction and simulation of 3-D structure of biological tissues.