

# 3D cellular automata method of oncolytic virotherapy in pancreatic cancer

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## SCOPE OF THE METHOD

<b>The Method relates to</b>	Human health
<b>The Method is situated in</b>	Translational - Applied Research
<b>Type of method</b>	In silico
<b>This method makes use of</b>	Animal derived cells / tissues / organs

## DESCRIPTION

### Method keywords

cell proliferation

mutation

apoptosis

cellular automata model

hybrid model

partial differential equations

pancreatic cancer

oncolytic virotherapy

### Scientific area keywords

computational modelling

cancer treatment

mathematical model  
stochastic model  
probabilistic model  
Monte Carlo simulations

### **Method description**

We developed a cellular automata model of oncolytic virotherapy with an application to pancreatic cancer. The fundamental biomedical processes (like cell proliferation, mutation, apoptosis) are modelled by the use of probabilistic principles. The migration of injected viruses (as therapy) is modelled by diffusion through the tissue. The resulting diffusion-reaction equation with smoothed point viral sources is discretised by the finite difference method and integrated by the IMEX approach. Furthermore, Monte Carlo simulations are done to quantitatively evaluate the correlations between various input parameters and numerical results. As we expected, our model is able to simulate the pancreatic cancer growth at early stages, which is calibrated with experimental results. In addition, the model can be used to predict and evaluate the therapeutic effect of oncolytic virotherapy.

### **Lab equipment**

Only computer resources

### **Method status**

Published in peer reviewed journal

## **PROS, CONS & FUTURE POTENTIAL**

### **Advantages**

- The method does not need any animal tests;
- The model is able to simulate cancer progression at early stages;
- The model is scalable and the speed of cancer progression can be adjusted by variation of the input parameters.

### **Challenges**

Unfortunately, the experimental validation has only been carried out from a

qualitative point of view. A more quantitative validation is still missing. In the future, we aim at improving this, which also implies further model improvements, as well as adjustment of input parameters.

### **Modifications**

Further clinical experimental studies are necessary to optimise the viral therapy in terms of dealing with cancer, leaving as few viral particles as possible. A medical research group at the University of Twente, in the Netherlands, headed by prof Jain Prakash, is interested in the method to reproduce their clinical findings.

### **Future & Other applications**

We think that the model can be used to predict and evaluate therapeutic effects of oncolytic virotherapy.

## **REFERENCES, ASSOCIATED DOCUMENTS AND OTHER INFORMATION**

### **References**

J. Chen, D. Weihs, F.J. Vermolen. A cellular automata model of oncolytic virotherapy in pancreatic cancer. *Bull Math Biol* 82, 103 (2020), <https://doi.org/10.1007/s11538-020-00780-5>

### **Associated documents**

### **Links**

[Fred Vermolen at Computational Mathematics](#)

### **Other remarks**

The method was developed in the framework of the PhD-research by Dr. Jiao Chen at the Delft University of Technology in the Netherlands. Fred Vermolen has acted as the daily supervisor, and he has, during the project, moved the university of Hasselt. Furthermore, Prof Daphne Weihs, from Technion in Israel, has contributed as an external expert.

## **PARTNERS AND COLLABORATIONS**

## Organisation

**Name of the organisation** Hasselt University

**Department** Department of Science

**Country** Belgium

**Geographical Area** Flemish Region

**Name of the organisation** Delft University of Technology

**Department** Delft Institute of Applied Mathematics

**Country** Netherlands

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