Computational Modelling with Single Prompts

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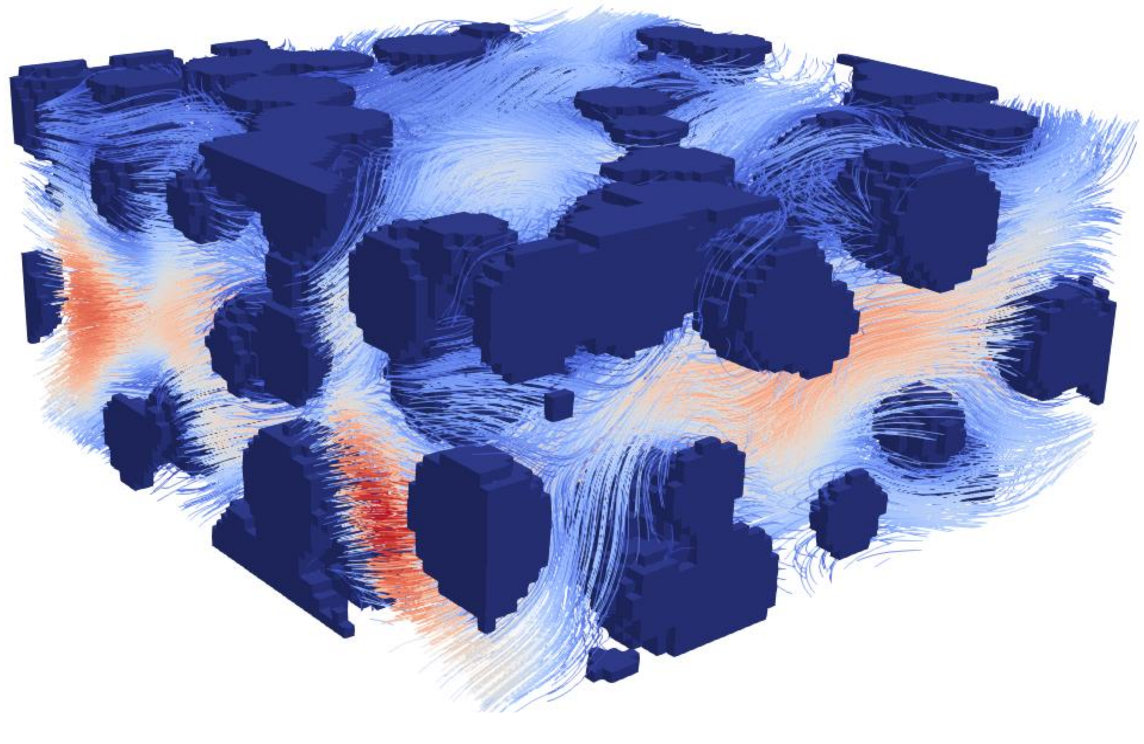

Figure: Streamlines in 3D flow through porous medium computed with code generated by ChatGPT 5.5 using single prompt given on the right panel. Visualization from VTK in Paraview.

Seminar on Single Prompts (YouTube)

Animation (YouTube)

Web application (be careful, physics not verified)

Web application URL: http://www.ift.uni.wroc.pl/~maq/inertial-singleprompt.html

Prompting in LLM (for future modeling)

Repeatibility (temperature).
Reliability – specific tests needed?
Focus (many possibilities).
Copyrights. Who is the author now?
Ask RIGHT questions.

Inertial Flows with **a single prompt**

Write an application as a single **JS HTML file**:

1. Implement the **D3Q15 Lattice Boltzmann BGK and TRT** method for fluid flow simulation in 3D, rectangular channel with periodic boundary conditions in all directions.
2. **Use gravity** in the horizontal direction (Guo forcing) **to accelerate the flow**.
3. Place spherical obstacles at random positions until the porosity is PHI (calculated for the whole domain). **Use no-slip condition** (velocity=0) at their boundaries. Add another deposition algorithm, in which the obstacles do not overlap and have a minimum edge-edge distance A. Obstacles may extend outside of the system and be partially beyond the edge, in that case they should be drawn periodically on the other side.
4. Represent the flow with **NP massless particles** following the **velocity field**. Remove and place those particles that penetrate or bump into obstacles. Place them in a new, random location. Particles also feel the **periodic boundary conditions**.
5. Calculate the **tortuosity** from the velocity field as the mean velocity modulus divided by the mean velocity in the x-direction. Measure the Reynolds number and apparent permeability from the Darcy's law.
6. Add sliders so that the user can vary the external force from minimum to maximum in any range (with the possibility of entering its value from a text box).
7. Make the panel of results (plots) on the right edge of the canvas. Each plot is unique**. Under each plot provide little GUI allowing the user to change parameters** of the measure. Add "Compute" button that starts serie of measures for each of the plots that sometimes include serie of computation. In that case, display appropriate progress bar showing the process and button "Stop" allowing the user to stop. The following plots should be included on the above-mentioned panel:
a) **Apparent Permeability** vs Reynolds number (fixed porosity)
b) **Tortuosity** vs Reynolds number (fixed porosity)
c) **PI (participation number)** vs Reynolds number (fixed porosity)
d) **Tortuosity vs porosity** (for fixed Reynolds number)
e) **Rho_minus** (normalized area covered by backward flow) vs Reynolds number (fixed porosity)
f) **Rho_minus** (normalized area covered by backward flow) vs Porosity number (fixed Reynolds number)
Group measurements such that those that can be measured together on the same simulation results are measured together.
8. Measurements should be taken at steady state where **steady state condition** is based on the maximum change in tortuosity between a two time steps at **times t and t+50**. Always inform about steady state convergence in the form of instant plots in computational time.
9. Use compact GUI with buttons and text fields to allow user to change parameters: PHI, NP, A, convergence criteria epsilon, and other specific plots-related parameters.
10. Add possibility to **export velocity field from the computation into VTK** (ascii text) file possibile to be imported **into Paraview**.
11. Add a slider to control the delta time used for the time integration of massless particles in the animation (with the possibility to type manually in the text box, value unlimited).
12. Initially set the size of the **computational grid to NXxNYxNZ (80x80x40)** and allow to vary that.
13. Make sure the simulation is stable, **test the CFL condition**.
14. Visualize the flow with particles with **fully 3D with transparent, voxelized obstacles**.

copy & paste to ChatGPT 5.5...

Bibliography

[1] Sahrish B. Naqvi, Damian Śnieżek, Dawid Strzelczyk, Mariusz Mądrala, Maciej Matyka *Inertial effects on fluid flow through natural media* Water Resources Research 1 (2026)
[2] Damian Śnieżek, Sahrish B. Naqvi, and Maciej Matyka, *Inertia onset in disordered porous media flow* Phys. Rev. E 110, 045103 (2024)
[3] Maciej Matyka, *Computational Modelling with Single Prompts*, Routledge (Taylor & Francis Group), 2026 (in press)

Computational Modelling with Single Prompts provides an overview of computer models of physical phenomena and more. Each chapter is about a different model and contains a complete description, together with the algorithm and the result of the operation. There is no mathematics extended to its limits. The book provides a complete description, allowing readers to implement the algorithm themselves. The artificial intelligence (AI) elements in the book relate to the computer implementation and the programs that have been generated on the basis of the algorithms written. The results of these programs have been used as illustrations in the book. The book is mainly of use to graduate students working in computational physics, biology, chemistry, and computer science.

Taylor & Francis Group
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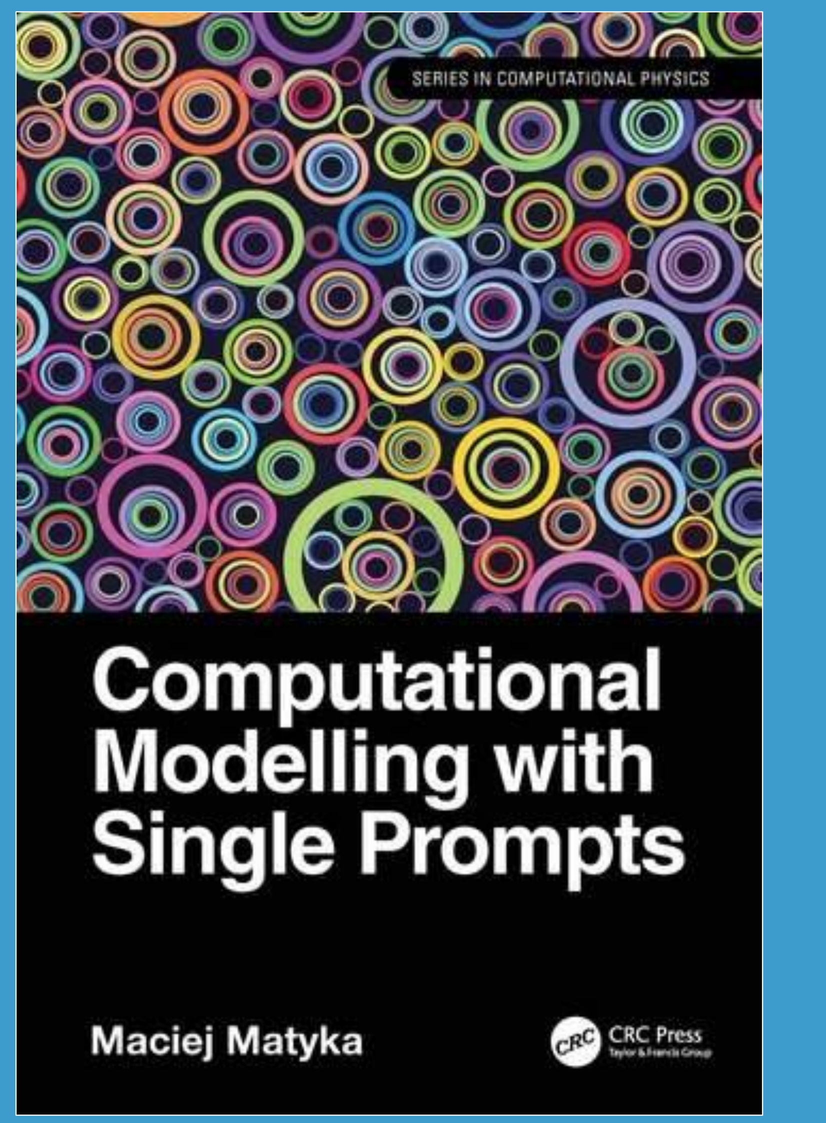
Key Features:
• Provides a large collection of very diverse models, the compilation of which is unique
• Includes elements of AI and the use of large language models (LLM).
• Consists of a collection of new ideas and additional tasks to be completed independently by the readers.



(July 2026)