UNIVERSITY OF TWENTE.

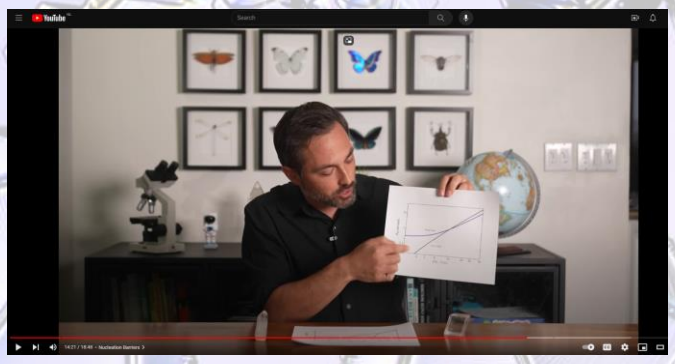
Master's assignment description (Mechanical Eng/Phys of Fluid)

Molecular Precision: Advanced Frost Growth Modelling

Abstract

Embark on a groundbreaking project to unravel the secrets behind snow crystal formation. You will study the basic kinetics of snow crystal growth and learn about the intricate effects of diffusion-limitation and anisotropic attachment to finally master the art of frost growth. Create a model to showcase what you have learned, displaying the inner workings of crystal growth from the microscopic to the mesoscopic. This project will have its impact on the burgeoning fields of aeronautics, HVAC and domestic heating (IE. LG, Daikin, Bosch, Hitachi) to further push the envelope of efficiency.

📚 **In-Depth Inquiry:** Undertake a comprehensive examination of snow crystal kinetics by immersing yourself in snow with fascinating learning opportunities from various sources such as Veritasium on Youtube (Why are snowflakes like this? (youtube.com)) and engaging reads such as *Snow Crystals* by Kenneth G. Libbrecht, among other scholarly texts. Uncover the underlying principles that govern the crystal shapes and hone your skills in theoretical analysis and numerical replication.



🔬 **Replicating Models:** Engage in thoughtful analysis to understand the nuances of snow crystal formation, allowing for active understanding and interpretation of the dynamics at play. Then elevate your understanding by diligently recreating the most important models outlined in your chosen literature. This project serves as a hands-on lesson for developing scientific methodologies and taking cutting-edge scientific theory into practice, fostering skills that extend beyond the immediate scope of snow crystal formation.

🚀 **Expand the Scientific Understanding:** Use your hard-earned skills and understanding to evaluate and improve existing frost models. Provide insight into the shortcomings and advantages of models like those used to control Air-Source Heat Pumps (ASHPs), advancing the understanding of the field. You will provide the key strategic expertise needed to improve novel, spatially non-uniform frost models developed at the University of Twente.

🧠✨ **What you will gain:**

- Key insights into state-of-the-art frost measurement and modelling techniques.
- Expertise in heat and mass transfer through microporous structures.
- Advanced MATLAB/Python/Openfoam/Dedalus/C++ modelling experience, depending on your chosen platform.
- Skilled hands-on guidance and experience in novel scientific research.

🎓 **Ideal candidate profile:**

We are looking for a highly motivated student (Mechanical Engineering, Physics of Fluids) with an interest in becoming a true Master of heat transfer, nucleation, phase change, porous structures and mathematical modelling. Work ethic, interpersonal skills, scientific curiosity, and a desire to grow in your professional career as a thermal numerical modelling specialist are excellent qualities for this project. Candidates with previous

experience in modelling, heat transfer and interest in the dynamics behind the formation of solid-state structures are preferred.

Location: Physics of Fluids/Heat Transfer and Thermodynamics (HTT) group
Supervisors: 1 Faculty dependent supervisor TBD, Ir. A Labuschagne
Part-time/Possible supervisors TBD: Prof. Dr. -Ing. Wilko Rohlfs, Dr. Rui Yang, Dr. Martin Luckabauer, Jaimy Gebbeken

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