

# Modeling Chaotic and Structured Bubbling with Active Living Forces

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# About Us

## Eric Gonzalez

- Sunset Park, Brooklyn
- Brooklyn Tech
- Product Manager
- Ornithology and video games



## Mohmed Bemat

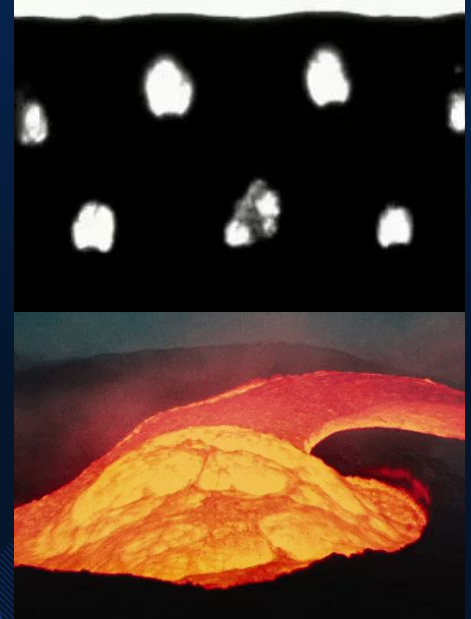
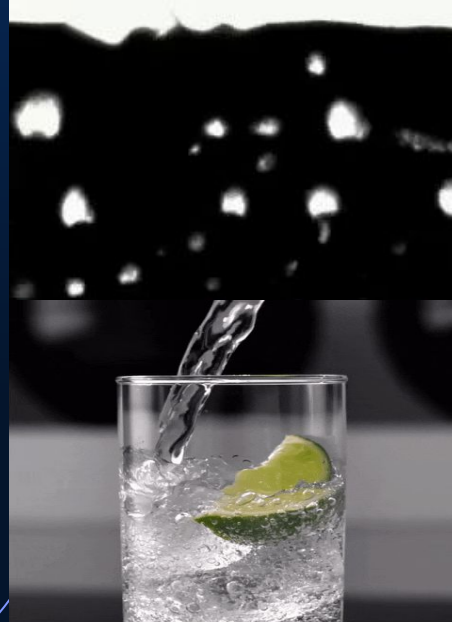
- Bronx, New York
- The Bronx Center for Science and Mathematics
- Software Developer
- Technology and basketball/football



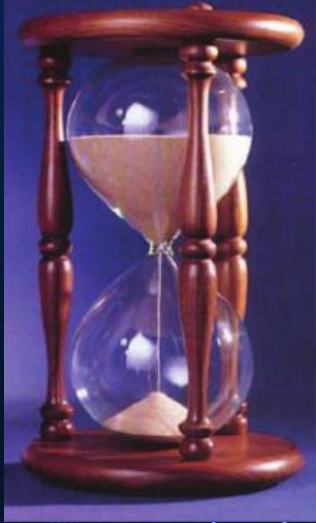
# Introduction



- ▶ Structured bubbling:  
Bubble patterns with  
consistent vibrations
- ▶ Free Bubbling:  
randomized bubble  
patterns



# Introduction



- ▷ Granular particles can behave like solids, liquids, or gas, according to the different shears.
- ▷ Many hydrodynamic instability analogs have been also found in granular particles

## Motivation



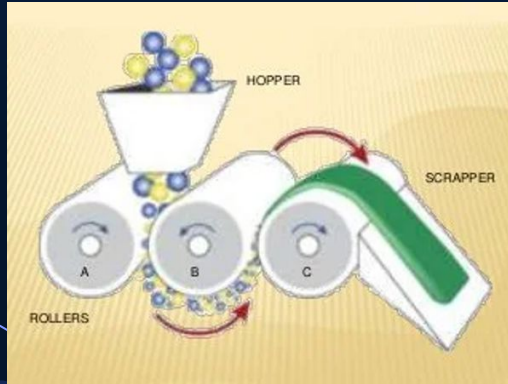
- ▷ Reducing Food Waste with Soldier Fly Larvae



# Motivation

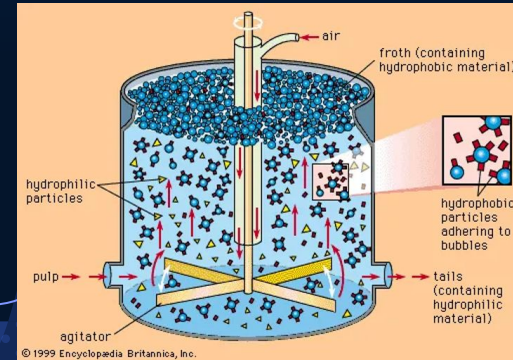
## Pharmaceutical industry

- ▶ Pharmaceutical tablets require exact mixing of active and passive ingredients



## Mining industry

- ▶ Dry separation of granular particles on the basis of size, density and shape can reduce water and energy input to make mining more sustainable



## Methods



### ▷ Learned different softwares

- ▶ Anaconda
- ▶ MFiX
- ▶ MobaXterm
- ▶ WinSCP
- ▶ Paraview
- ▶ MatLab

#### ATTENTION ATTENTION! Very Important Notice

You are now on a login node. For any extended processing, please launch Slurm jobs via 'sbatch' and 'srun'.  
Running processes longer than a few seconds and/or involving more than one core is **STRICTLY FORBIDDEN** on this node.  
Users who break the above rule abuse this shared resource, cause delays for other cluster users, end up on our watch list - and eventually will get penalized. For more details, see:  
<https://confluence.columbia.edu/confluence/display/rcs/Terremoto+-+Submitting+Jobs>  
Thank you -  
Terremoto Support Team

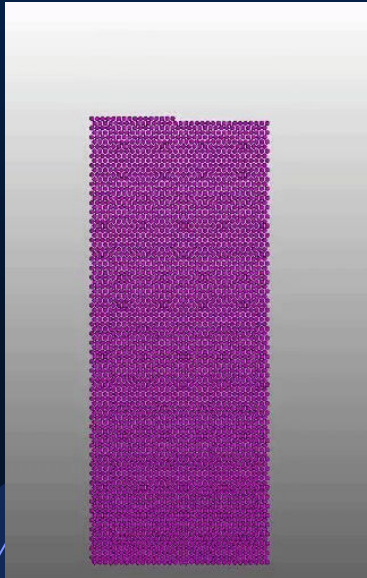
```
[eg3221@bake ~]$ cd /moto/cboyce/users/eg3221/fb-f_live0  
[eg3221@bake fb-f_live0]$ █
```



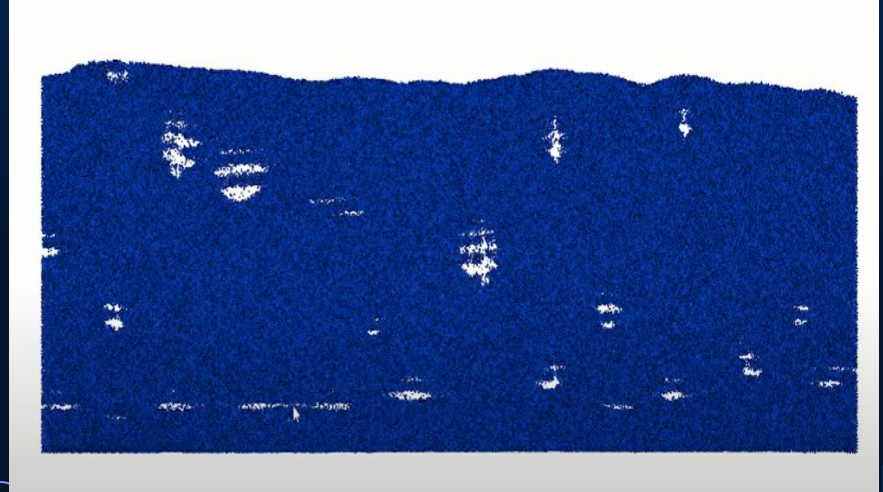
# Software Methods



**MFIX**



**Paraview**





# Software Methods

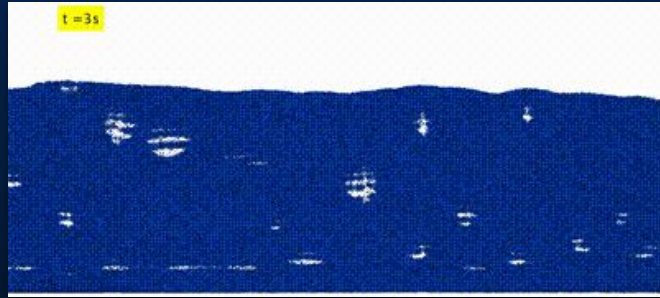


```
videos.m x +
-   clc;clear all;close all;
-   cd = 'D:\eng\sb-f_live7\figures\';
-   position = [100 8];
-   outputVideo = VideoWriter(fullfile('sb7.avi'));
-   outputVideo.FrameRate = 2;
-   open(outputVideo);
-   for i=1:21
-       im_ori_name=strcat(cd,num2str(i),' (',num2str(i),').jpeg');
-       im_ori=imread(im_ori_name);
-       im_crop = imcrop(im_ori,[49 80 1283 575]);
-       text_str=strcat('t = ',num2str((i-1)*0.2),'s');
-       RGB = insertText(im_crop,position,text_str,'FontSize',28,'BoxColor','yellow','BoxOpacity',1,'TextColor','black');
-       writeVideo(outputVideo,RGB);
-   end
-   close(outputVideo)
```

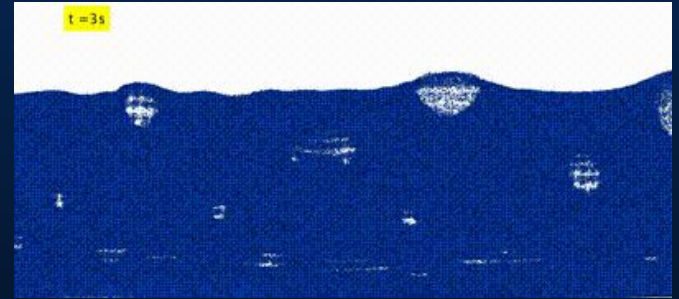
## Free Bubbling Cases Results



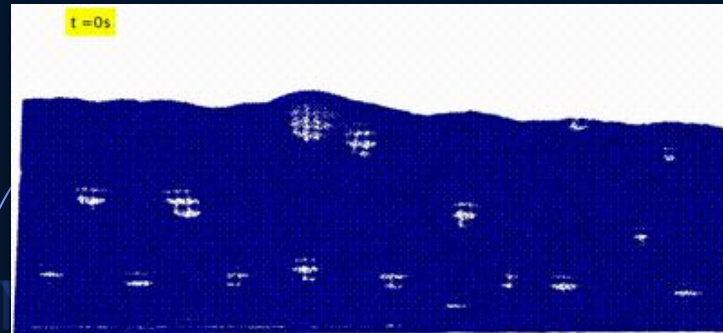
Std\_L=1e-0 N



Std\_L=1e-5 N



Std\_L=1e-7 N

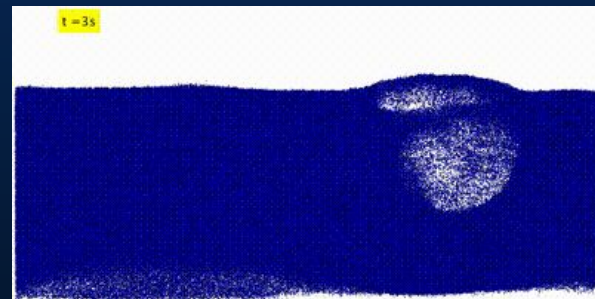
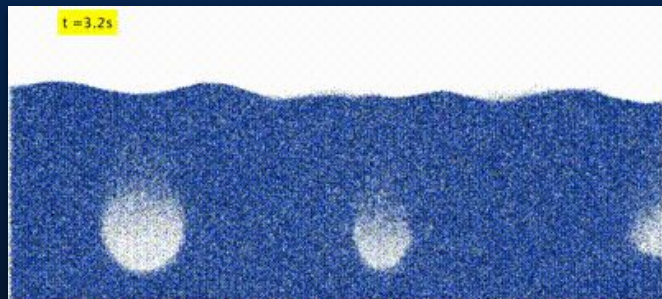


## Structured Bubbling Cases Results

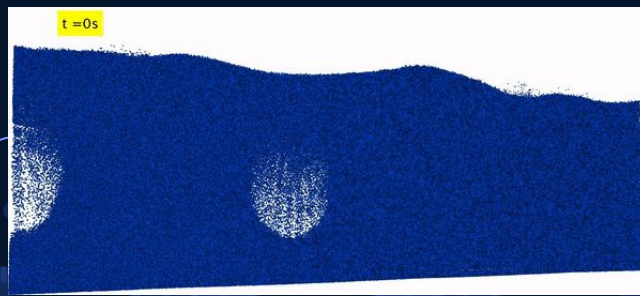
Std\_L=1e-0 N



Std\_L=1e-5 N



Std\_L=1e-7 N



## Summary



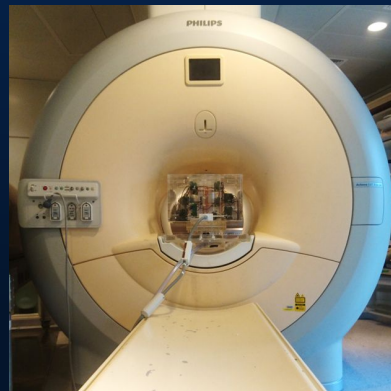
- ▷ CFD-DEM simulation can reproduce chaotic and structured bubbling
- ▷ Living forces affect structured bubbling much more than chaotic bubbling. It doesn't affect free bubbling since it's already chaotic
- ▷ Larger living force can affect it more.

## Next Steps



- ▶ For each active living forces, try more conditions (vibration and gasflow) to also produce similar bubbling patterns
- ▶ Do a force analysis to see the mechanism of the active living forces

# ENG Experience





# Acknowledgements



## Boyce Lab, Columbia University

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Kristian Breton  
The ENG Team and Cohort





# THANKS!



Any questions?