# Report on Deep Learning Enhanced Background Oriented Schlieren for analysis of droplet Evaporation

Based on Work done by Partha Dutta , & KIRAN RAJ M

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## Introduction

The work is done to analyse the droplet evaporation after impact . This phe nomenon involves following multiphysics

1. Coupled Fluid Motion
2. Heat Transfer and Phase Change

the surrounding vapour cloud influences the evaporation rate and so on droplets lifetime and stability

## Objectives

### BOS Technique

in BOS technique , the fluid we want to study is placed between a random dot pattern and a camera ,then a picture is taken for refrence . then we take another picture when fluid is under study and compare both pictures .

## Setup and Methodology

### setup

1. background pattern : 20mm $\times$ 20mm field of view with dot size of 0.01mm( 1pixel)

and 54% dot coverage

1. droplet generation and impact condition :
   1. dilute acetone-water solution (1:3) ratio
   2. diameter of droplet : 2.5mm
2. geometric Parameter of BOS
   1. Z_grad : distance between background and heated substrate
   2. Z_lens : distance between lens and background

### Methodology

1. Two BOS video at 2000fps were recorded for reference and distorted background
2. frames were extracted , merged and cropped to 512 x 512 pixels
3. displacement field were obtained using cross correlation and physics based CNN to improve the quallity of BOS images

## Mathematical Modeling

Based on displacemnt field , required refractive index is found out

$$\frac{\partial n}{\partial x} = c\Delta x$$

$$\frac{\partial n}{\partial y} = c\Delta y$$

where $c = \frac{n_0}{2 z_{\text{grad}} \Delta x_p}$ , where $n_0$ is the refractive index of air , $\Delta z_p$ is the half widith of field of view obtained from image callibration .

Based on the boundary conditon of of refractive index of air around it refractive conditon of mixture is calculated to find out the concentration of droplet after impact

# Result Discussion and Conclusion

## Comparison of resultant displacement field

Cross corelation captures the overall droplet evaporation structure, but spatial window averaging reduces the effective resolution and increases the noise robustness

## Result and Conclusion

1. transverse droplet oscillations is observed after impact as evident in

resultant displacement field

1. these oscillation arise due to competition between initial impact inertial,

surface tension recoil and heat induced non uniform evaporation near the contact line on heated substrate