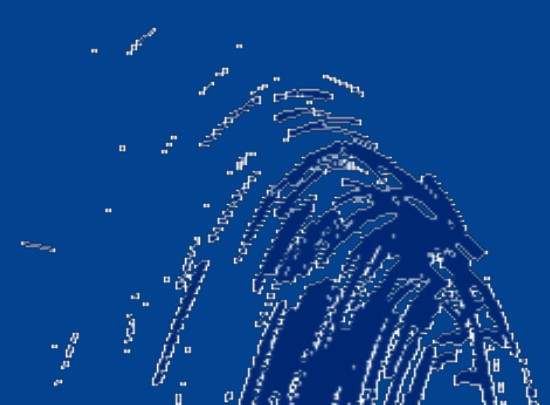
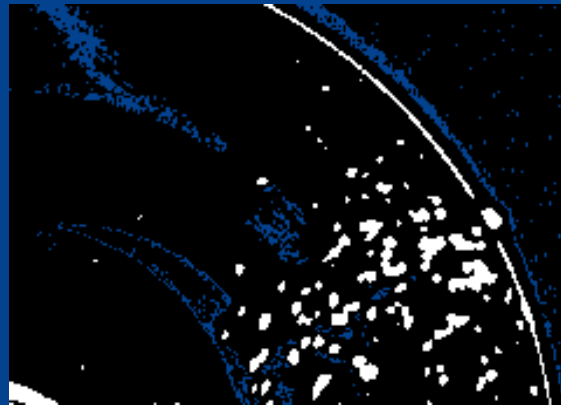
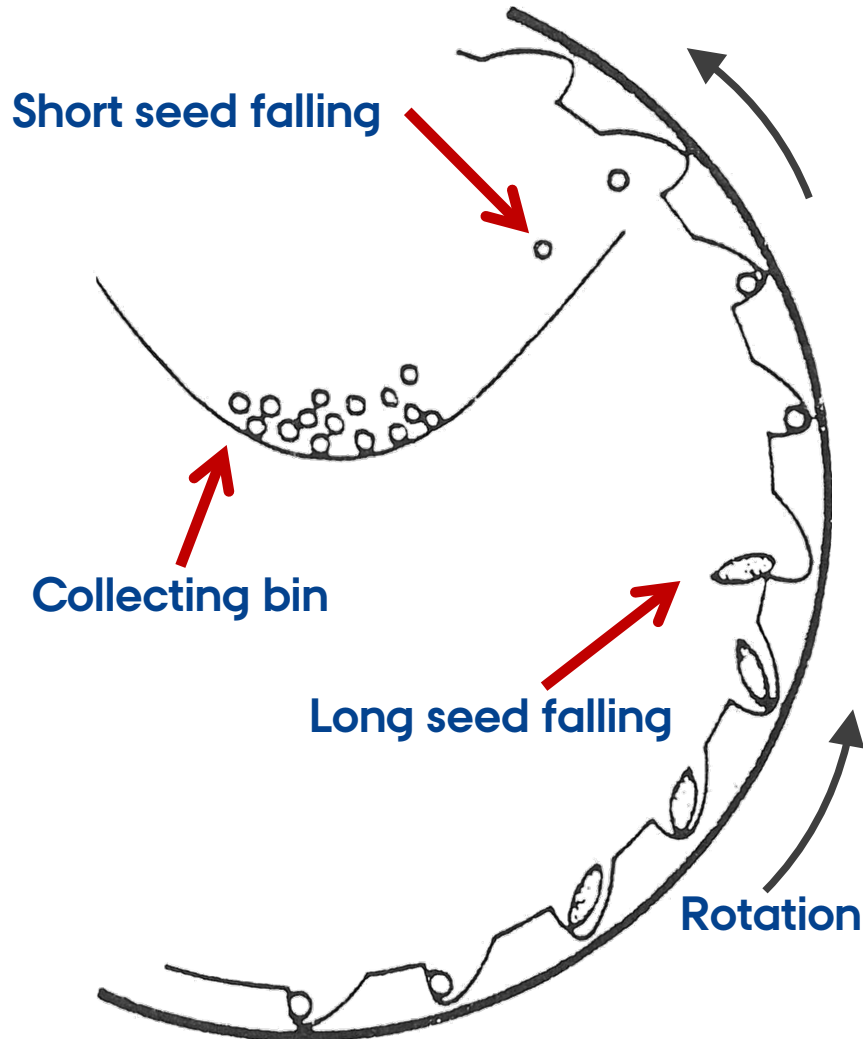


# Analysis of the Cleaning Process in the Indented Cylinder using Computer Vision

Ole Thomsen Buus, PhD student. Department of Genetics and Biotechnology, DJF

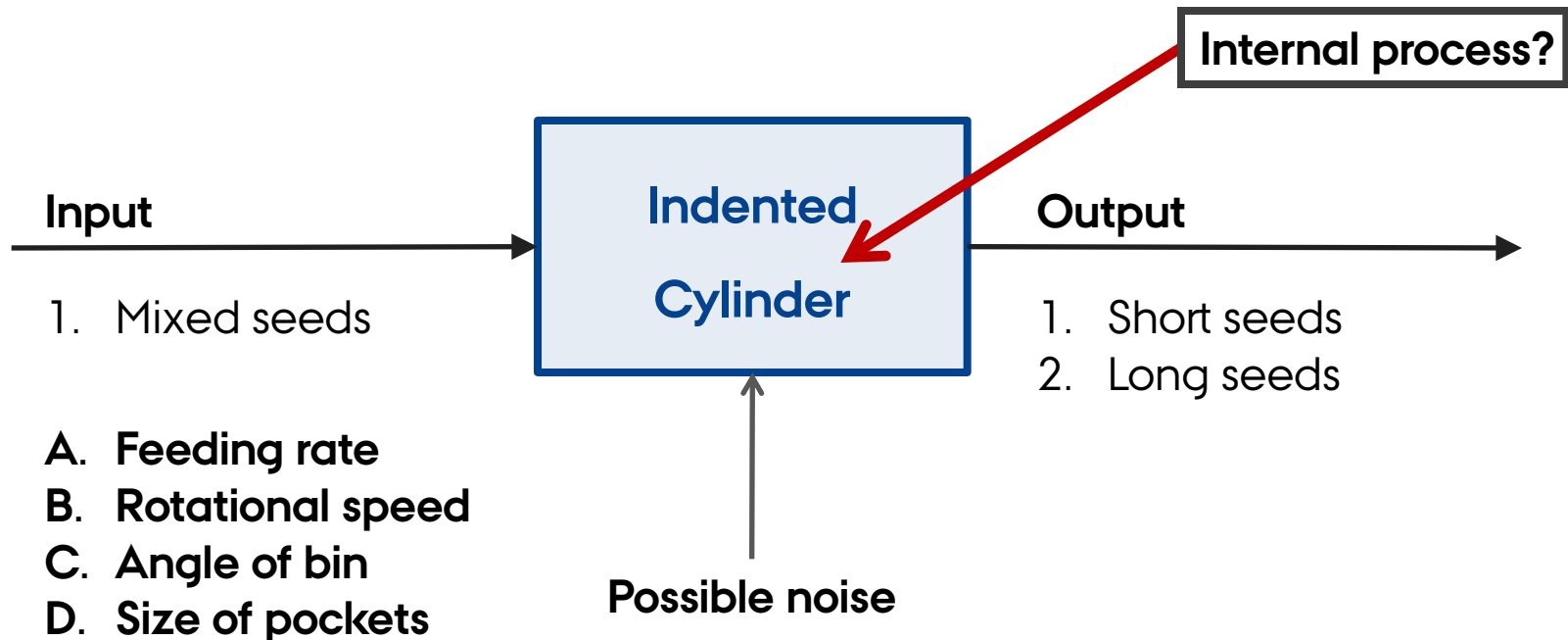




## Indented Cylinder?



# Toward an Input-Output model

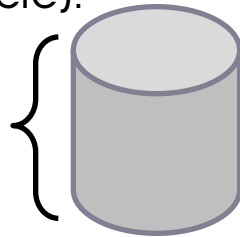


# We Investigated the Internal Process

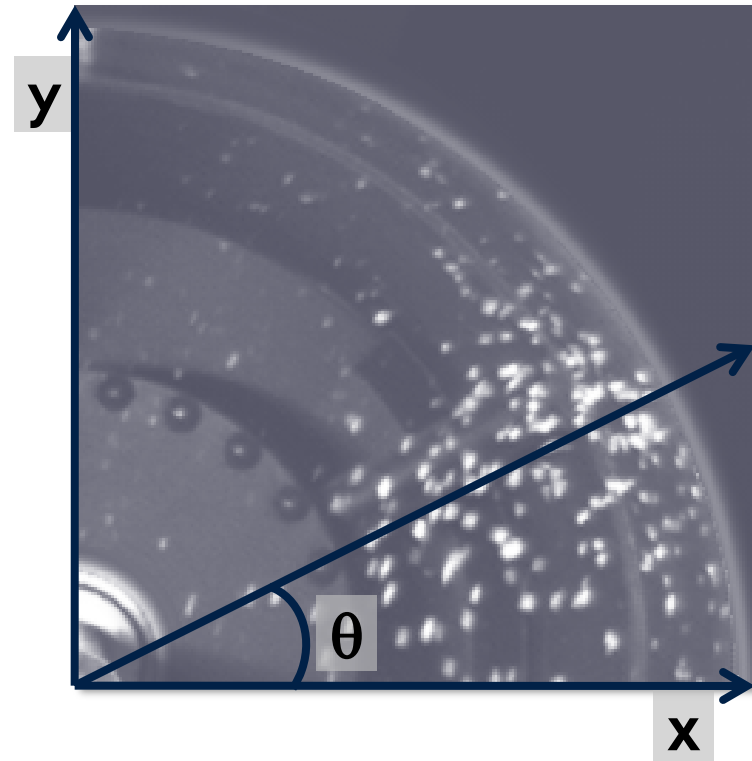
- › **Aim:** To get the distribution of the "angle of escape"  $\theta$ .
- › **Method:** High speed imaging and standard computer vision techniques
- › **Material:** 50% whole and 50% broken *barley* kernels (per particle):

Short particles (~0.667 g)

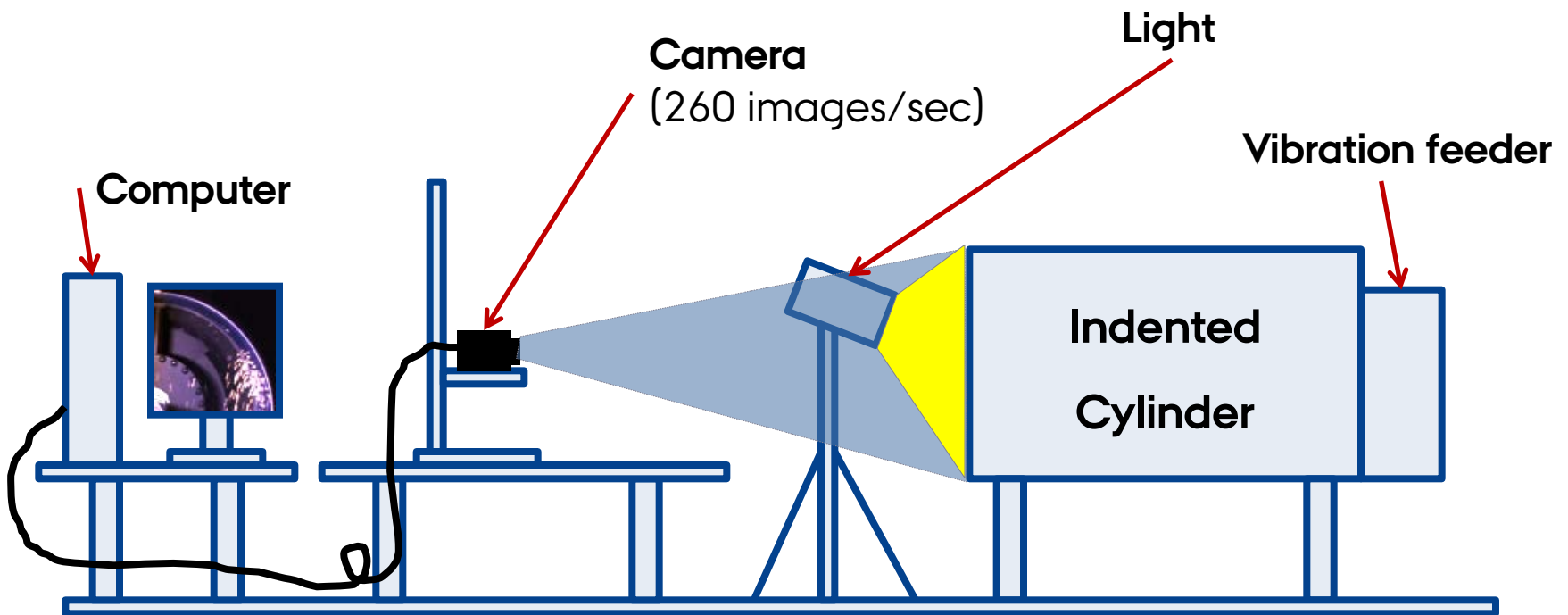
Long particles (~1.333 g)



~2 kg material



# Experimental Setup



# Video Data from the Experiments

Pocket size 1  
(6.0 mm)

01



Speed Step 1  
(~26 RPM)

02



Speed Step 2  
(~27 RPM)

...

10



Speed Step 10  
(~49 RPM)

Pocket size 2  
(7.0 mm)

11



Speed Step 1  
(~26 RPM)

12



Speed Step 2  
(~27 RPM)

...

20



Speed Step 10  
(~49 RPM)

# Speeds Steps 1, 5 og 9 (6.0 mm)

Speed step 1  
(26 RPM)



Speed step 5  
(36 RPM)

Speed step 9  
(46 RPM)



# Derivation of "angle of escape" $\theta$

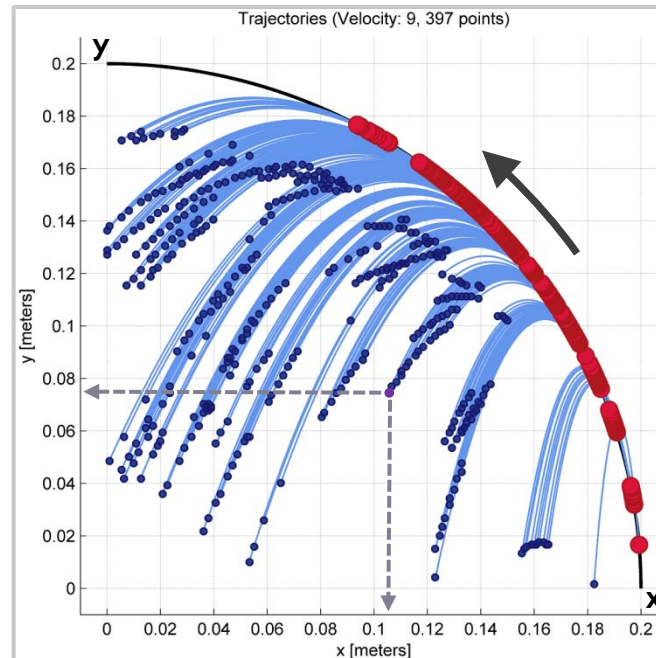
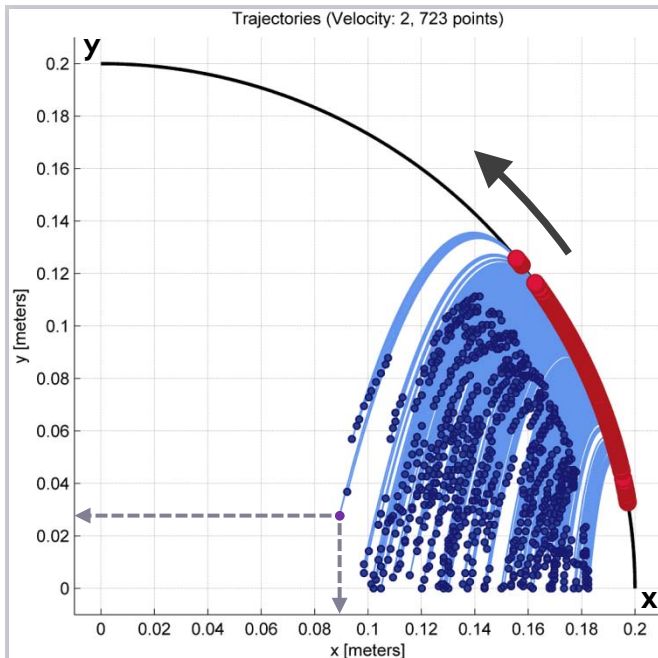
⑪

x	y
90	125
108	125
126	125
135	125
137	125
147	125
156	125
157	125
159	125
66	126

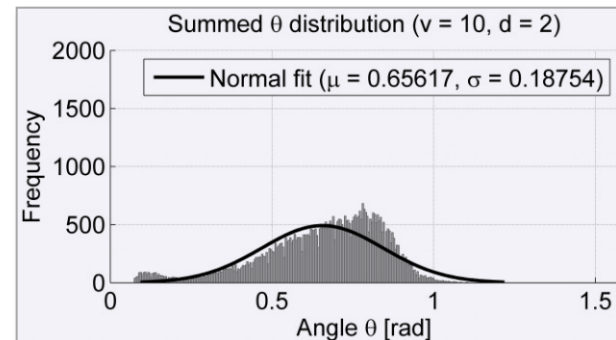
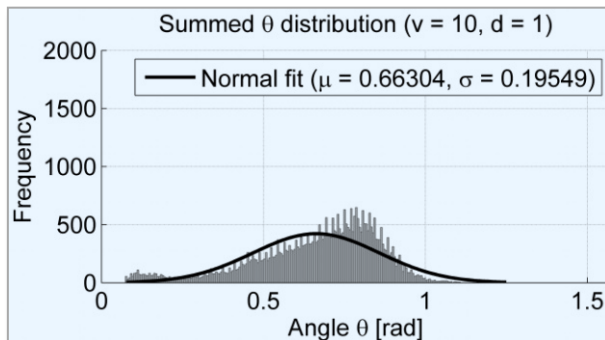
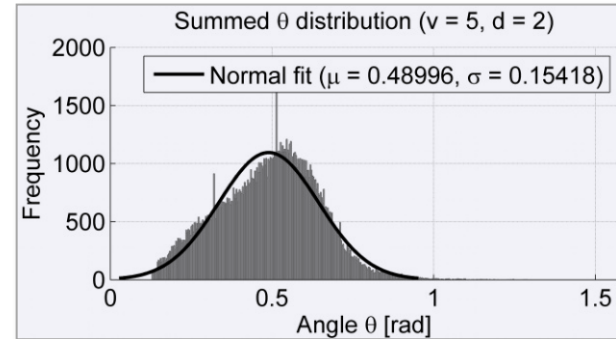
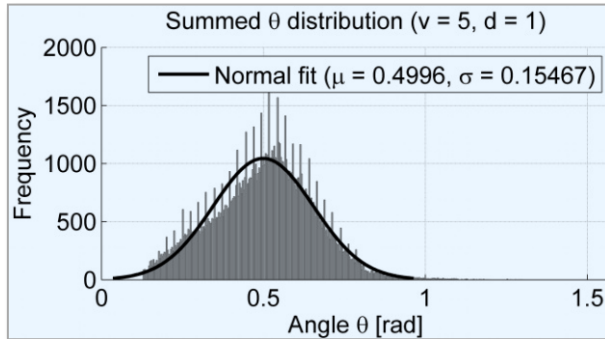
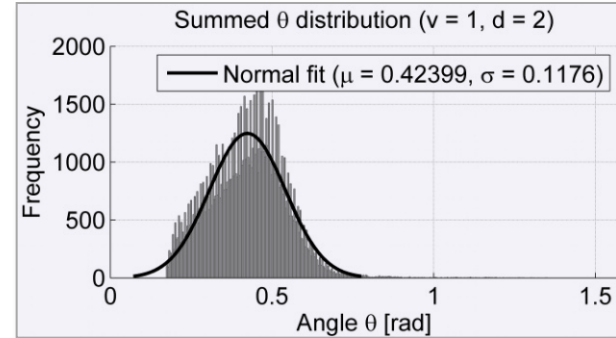
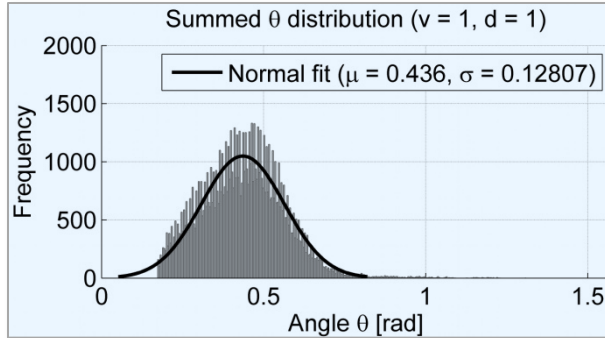
Locations in image plane

$$y = f(R, \omega, x, \theta)$$

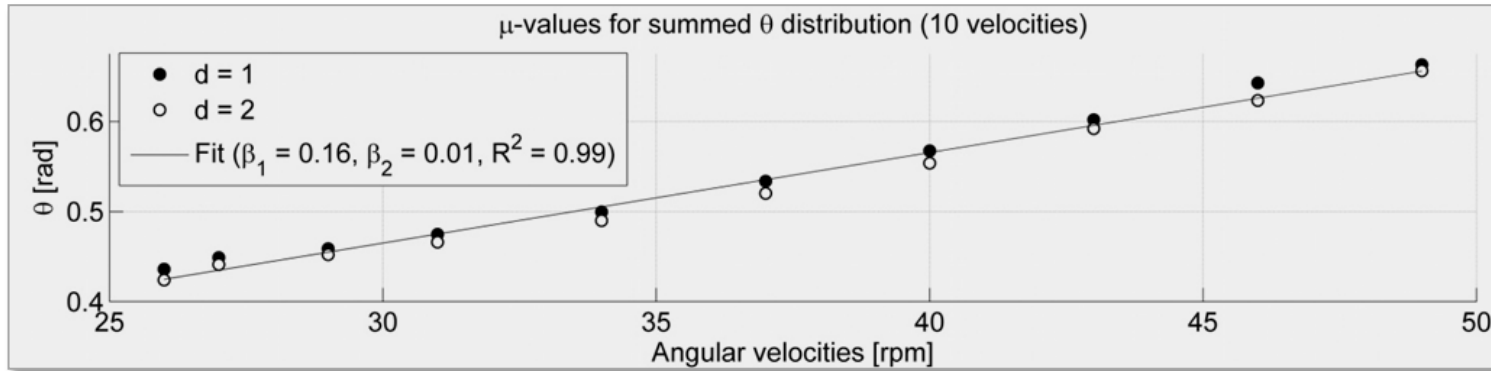
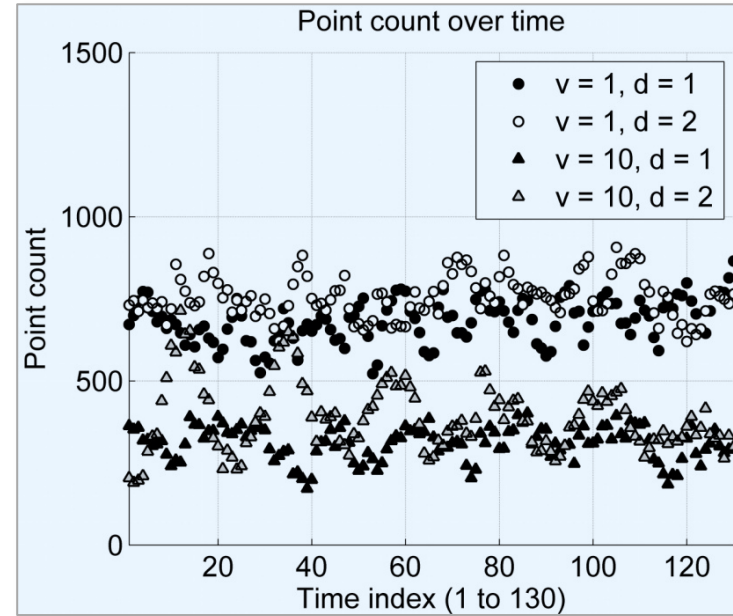
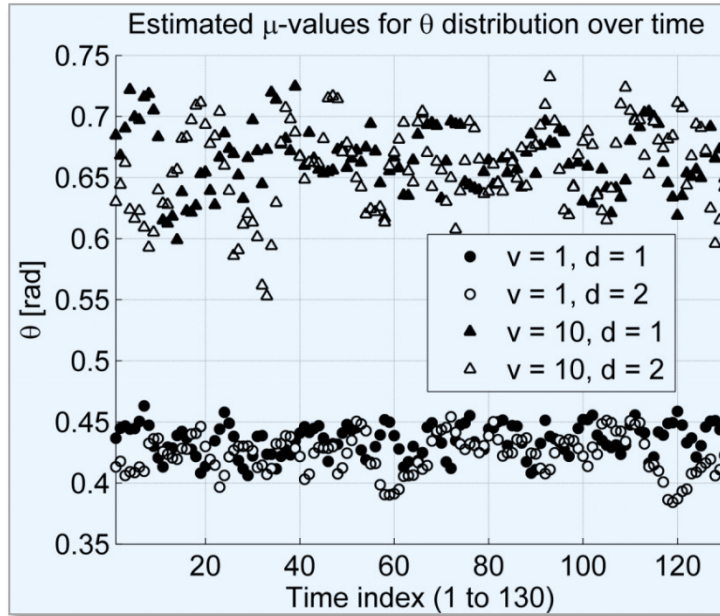
$R$  = radius of cylinder  
 $\omega$  = rotational speed  
 $\theta$  = angle of escape



# Estimated $\theta$ -distributions



# Process Stability



# Conclusions

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- › **1**- For faster rotational speeds the angle of escape has a skewed distribution.
- › **2**- The internal process seems to have some stability over time.
- › **3**- A linear relationship seems to exist between "rotational speed" and "angle of escape".
- › **Final remark** - We see no separation of particles/seeds. This is probably due to our choice of a mix consisting of 50% half and 50% whole kernels.

# Thank you

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1. Collages at Department of Genetics and Biotechnology, Faculty of Agricultural Sciences (GBI/DJF), Aarhus University.
2. Jens Michael Carstensen – Informatics And Mathematical Modelling, DTU.
3. Leif Goldbeck - Westrup A/S.