Balltracking method

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Structure

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Motivation

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- tracking photospheric flows of the surface of sun

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- method for evaluation and calculation of data from SOHO/MDI

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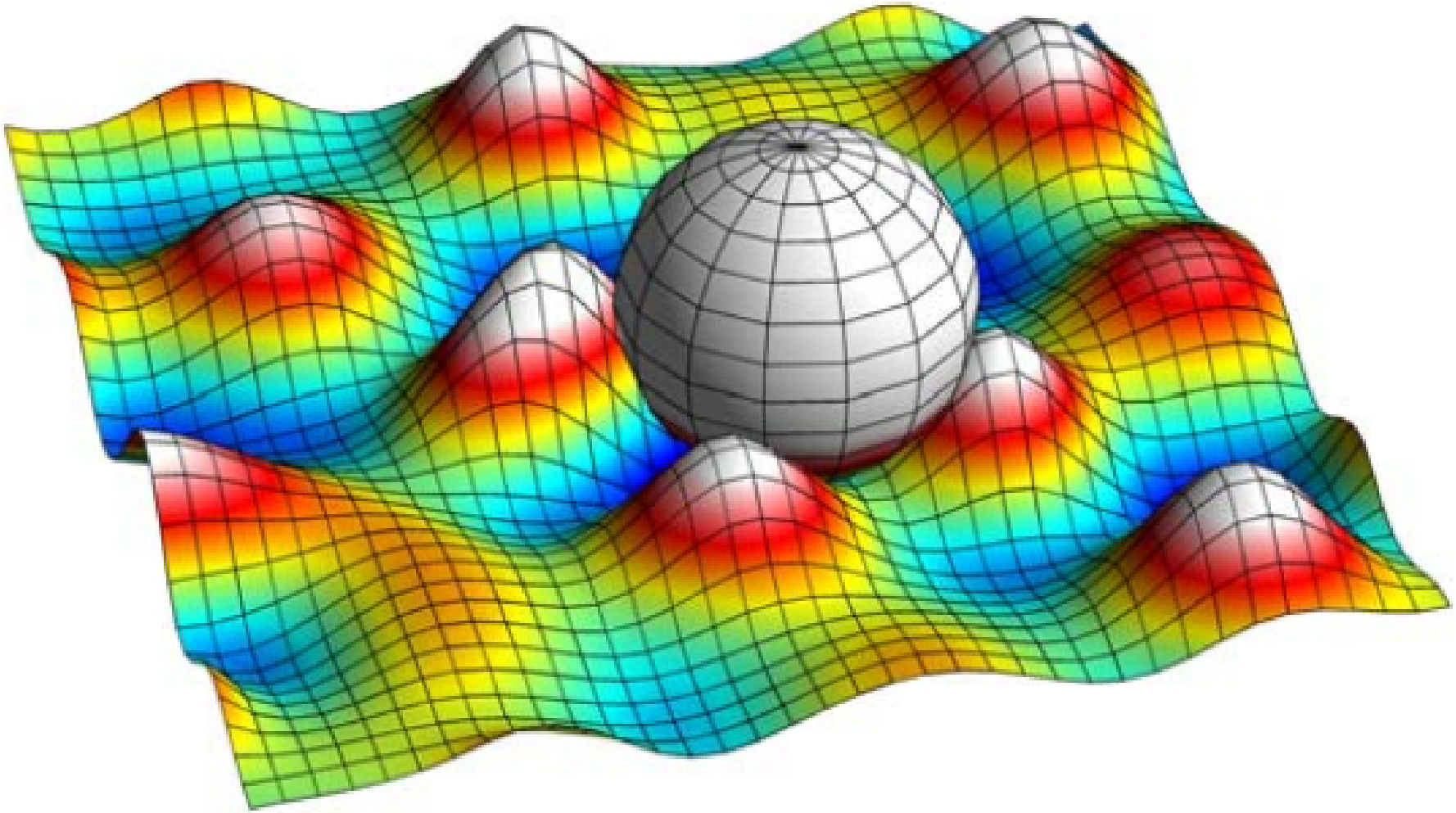
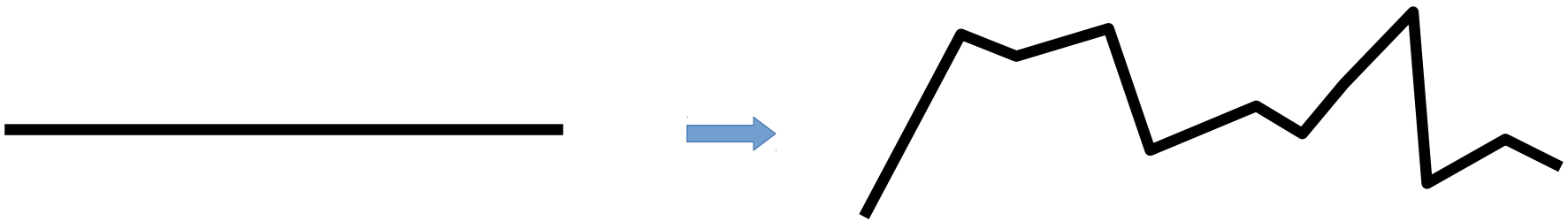
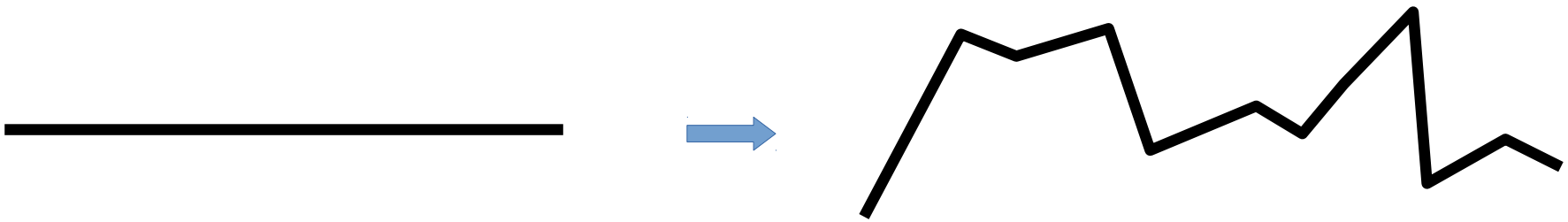
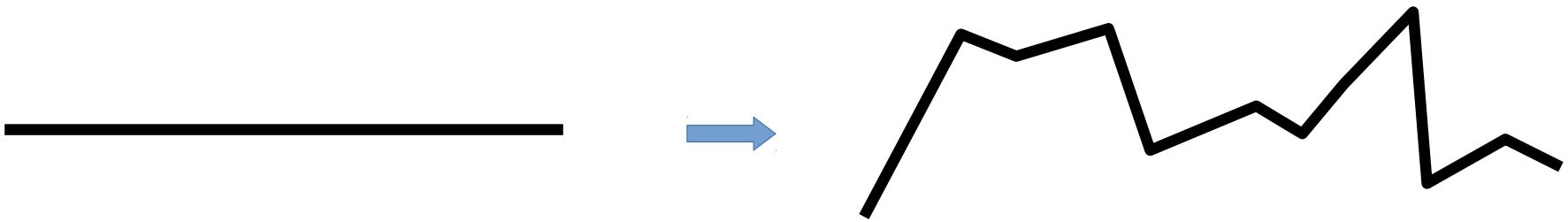
Main Idea

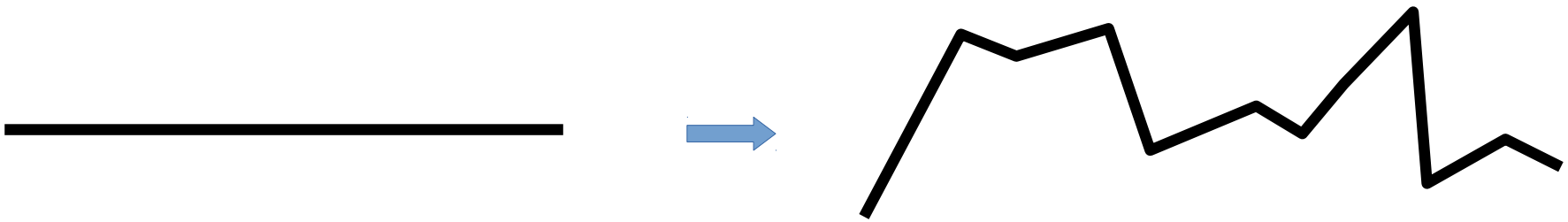




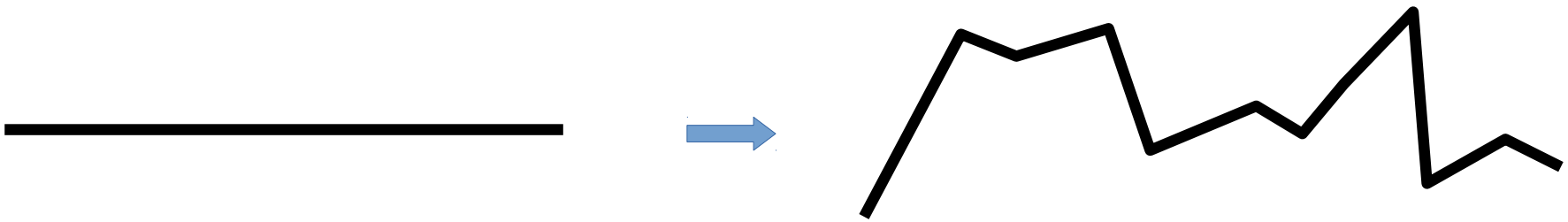




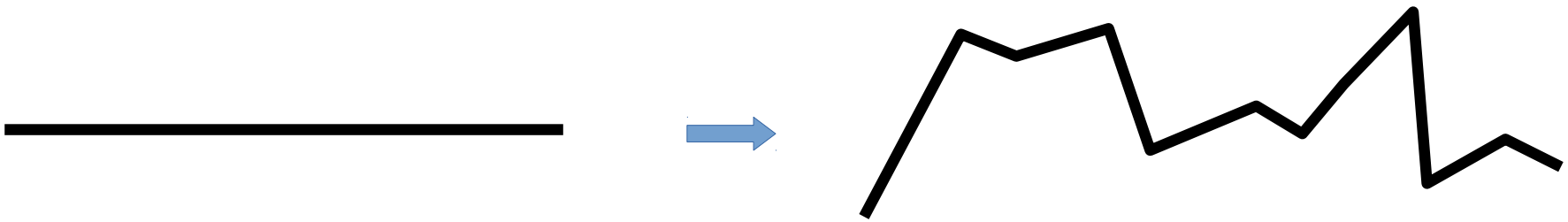
- consist of bumps which moves(random walk), disappears and forming



- consist of bumps which moves(random walk), disappears and forming
- interaction between the bumps



- consist of bumps which moves(random walk), disappears and forming
- interaction between the bumps
- tracking the bumps with floating balls



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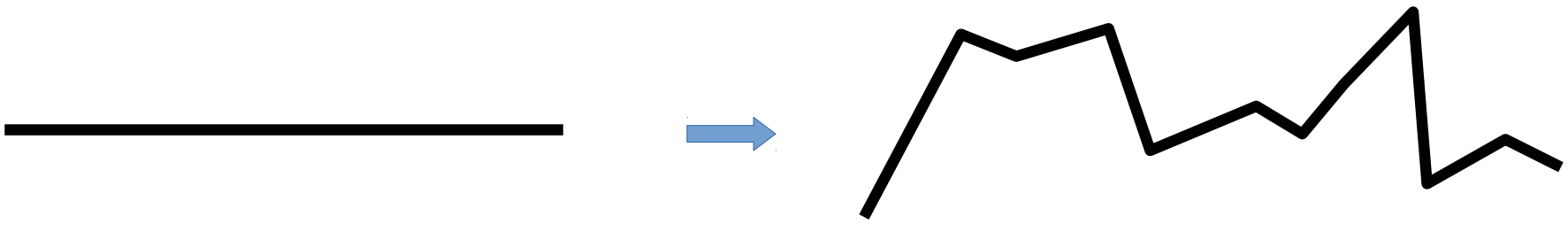

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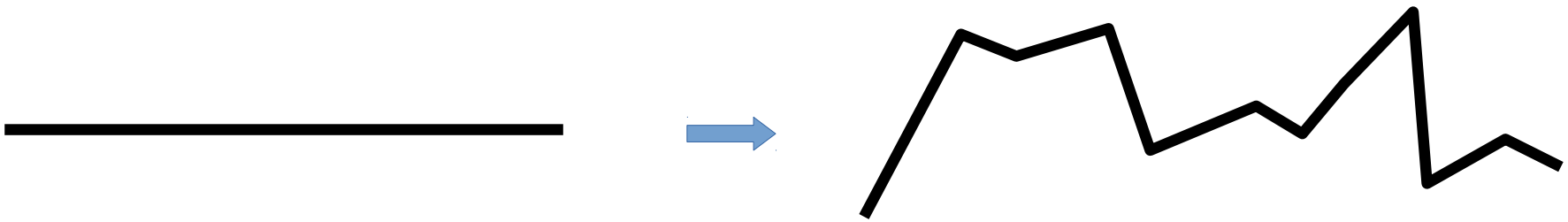
- bumps push the balls



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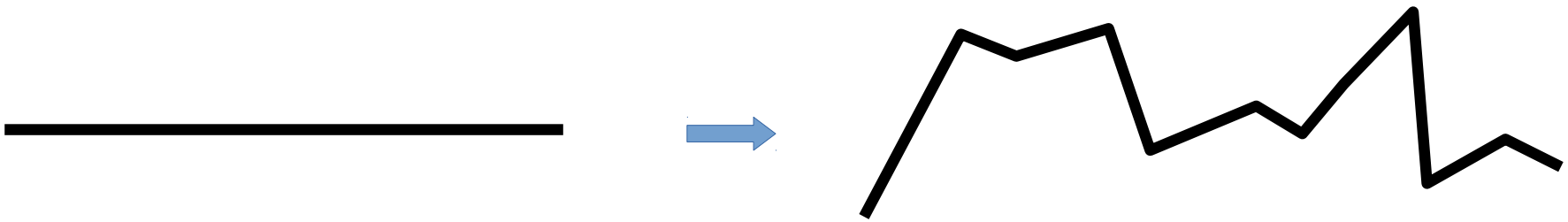
- approx balls have the average motion/direction of the bumps



- consist of bumps which moves(random walk), disappears and forming
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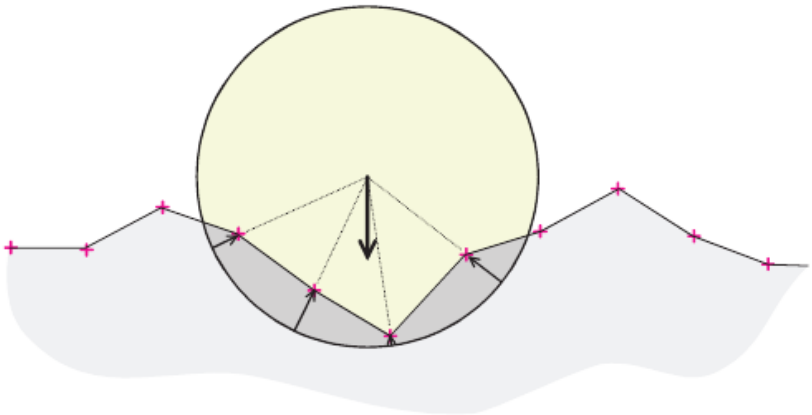
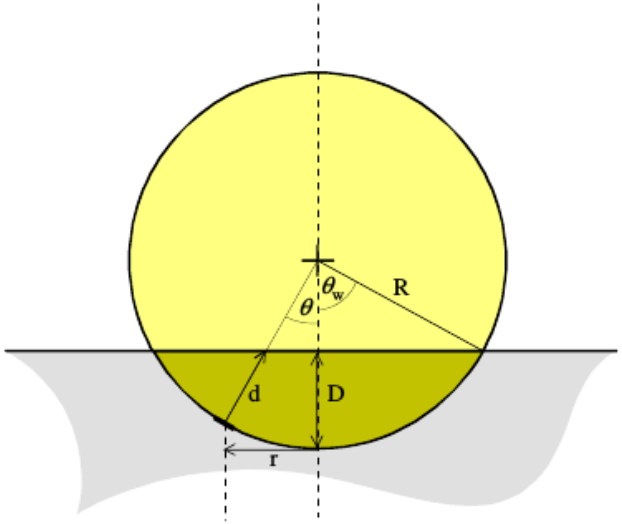
- bumps push the balls
- approx balls have the average motion/direction of the bumps
- prediction of mean motion of the bumps

Ball motion





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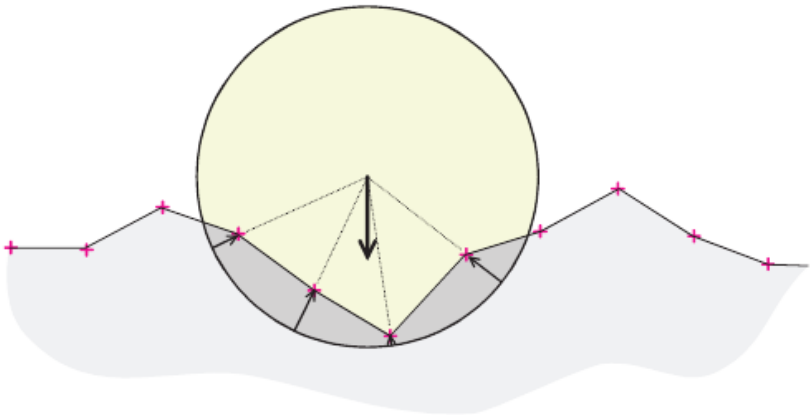

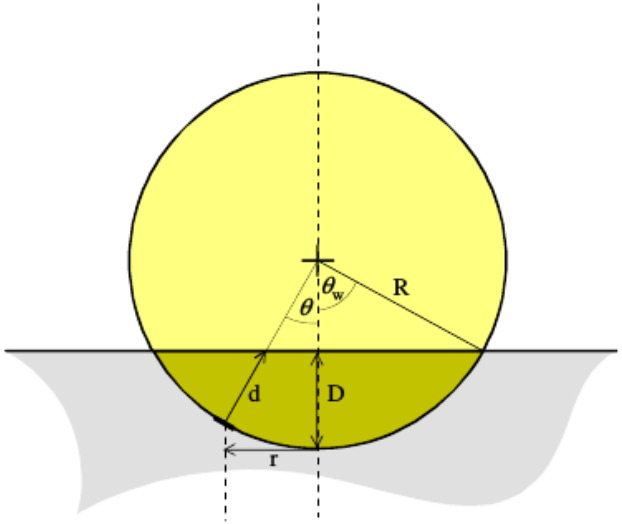

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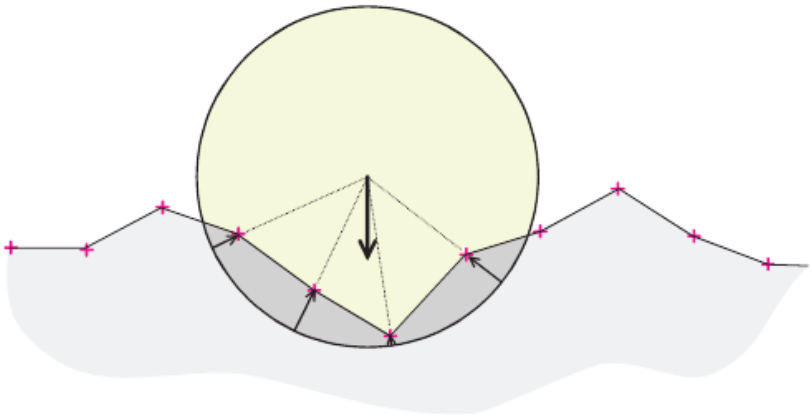
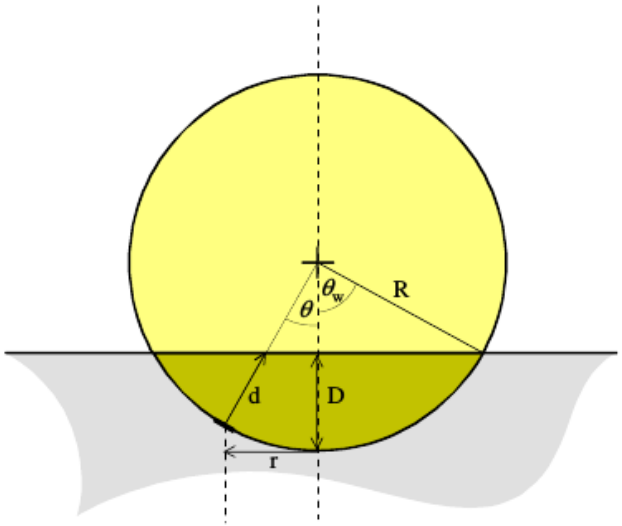
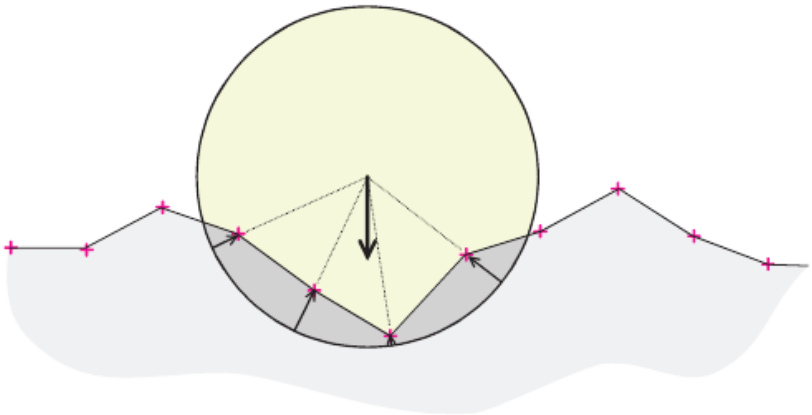
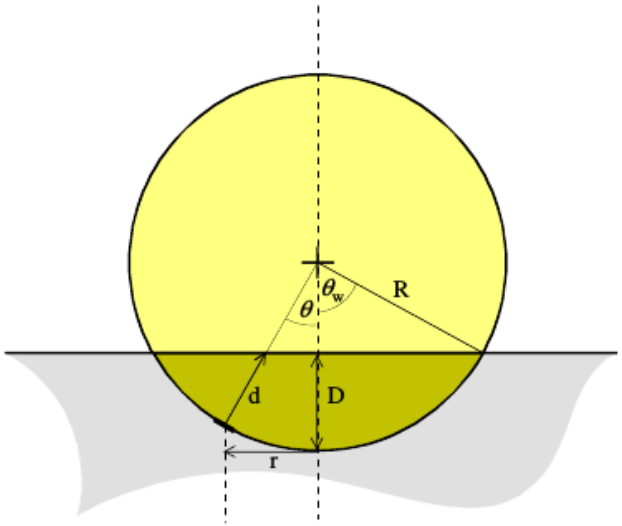




- $m\dot{\vec{v}} = \sum_i \vec{f}_i - m\vec{g} - \alpha\vec{v}$

Ball motion





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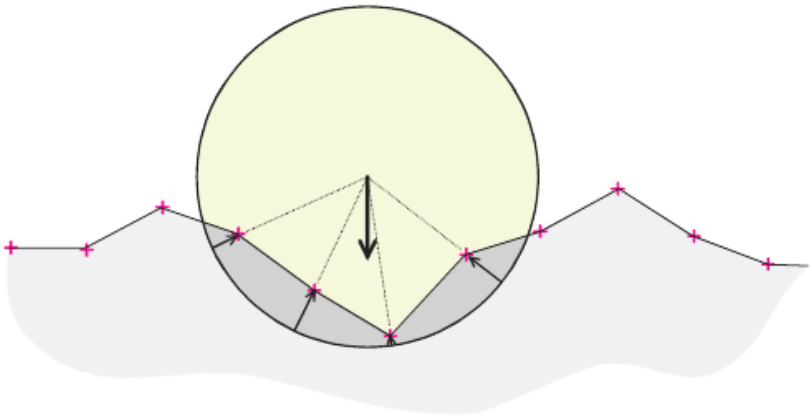
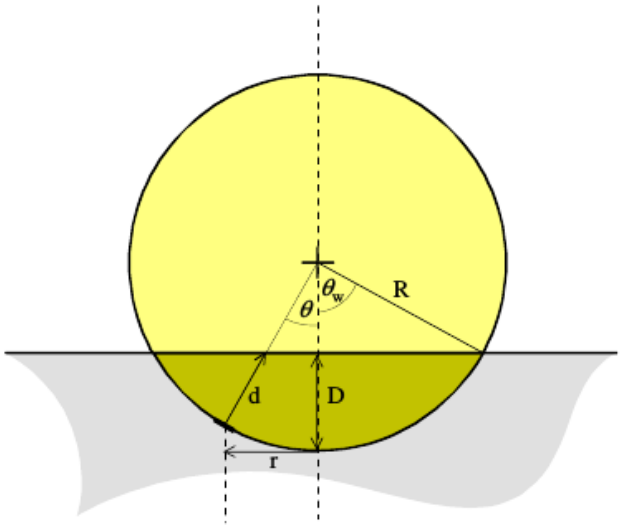
- $\vec{f}_i$ penetration force at each data points at the ball

Ball motion





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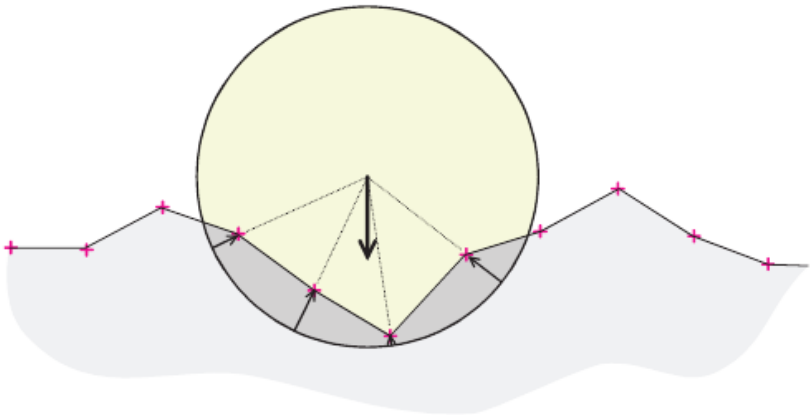

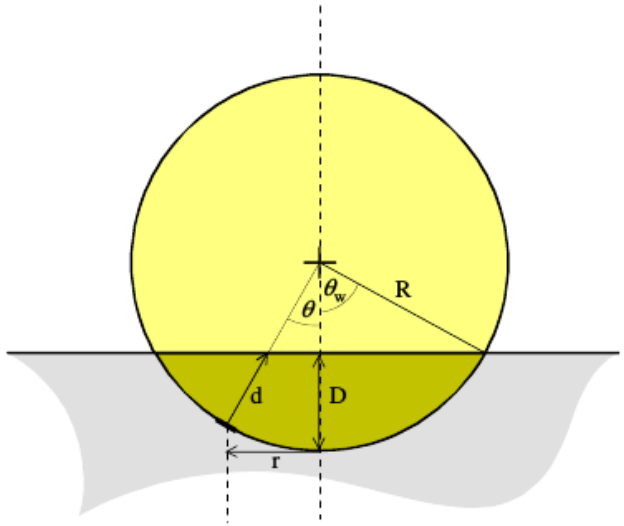

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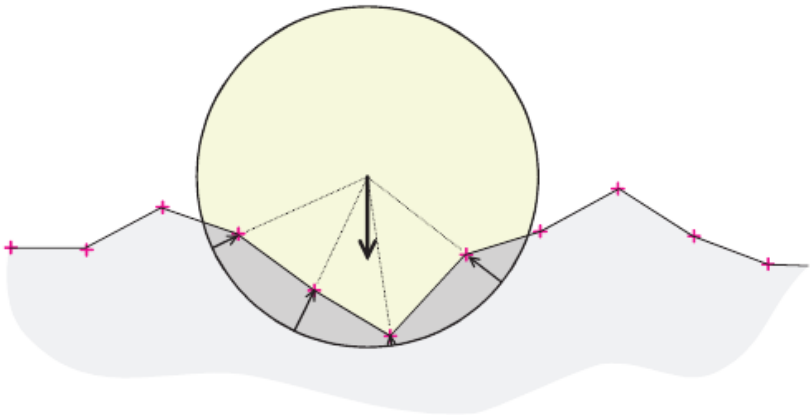
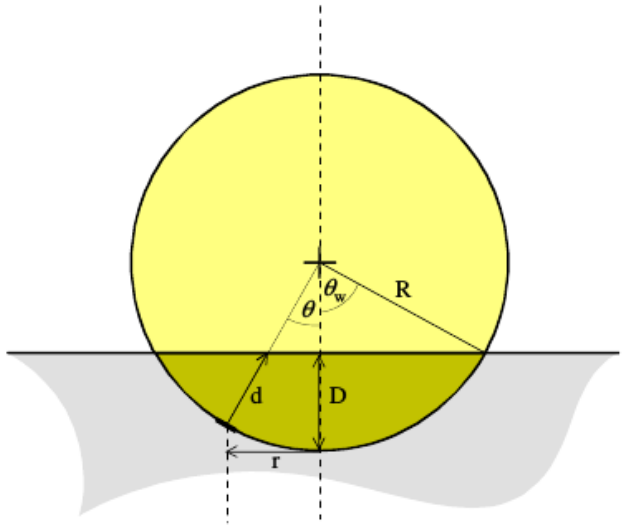
Ball motion





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- $\vec{f}_i$ penetration force at each data points at the ball
- $m\vec{g}$ gravitation force and $-\alpha\vec{v}$ damping force
- $d\vec{v} = dt\left(\frac{\tilde{A}_m}{\pi\tilde{D}_p^2\tilde{R}_s^2}\sum_i \tilde{d}_i - \tilde{A}_m\hat{g} - \frac{\vec{v}}{\tilde{T}_d}\right)$

Steps to Analysing data

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- 1: choose number of balls

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- 2: divide data surface in a grid and randomly set balls in grid cells
- 3: let the balls settle down to the nearest local minimum

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- 4: update the surface to the next time step

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- 5: bumps moving, disappearing, forming and pushed the balls to the next local minimum (store new position)

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- 6: remove any balls which too close to each other balls and falling off the edge

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- 1: choose number of balls
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- 2: divide data surface in a grid and randomly set balls in grid cells
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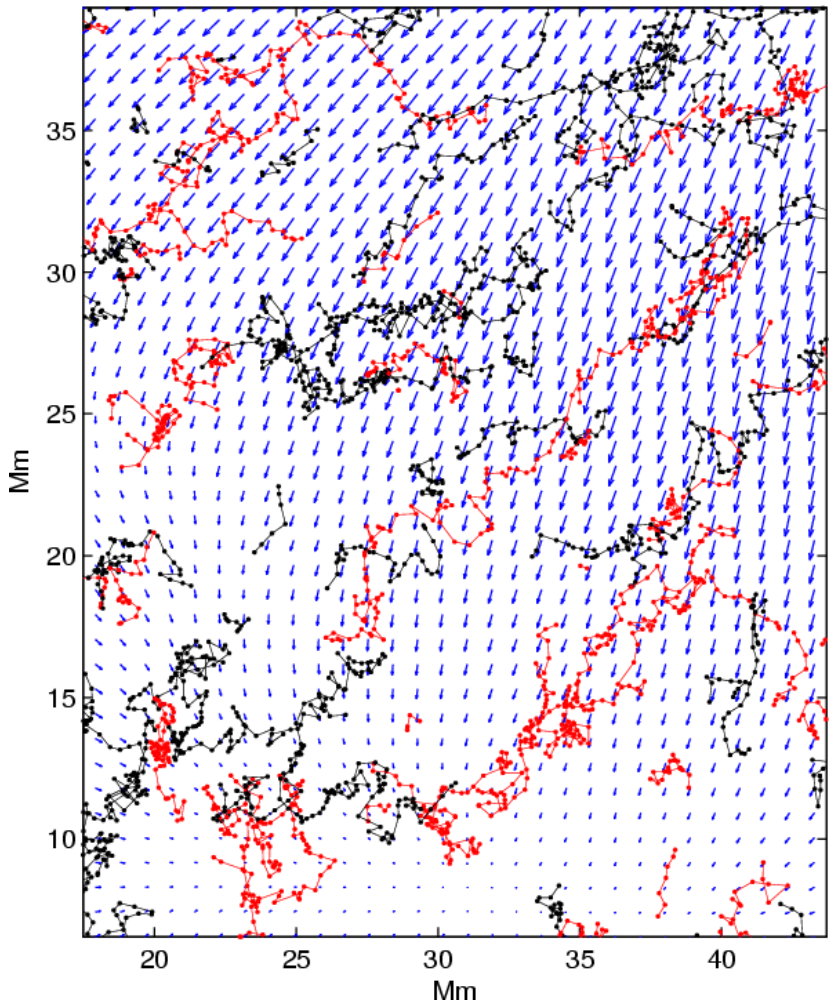
- 4: update the surface to the next time step
- 5: bumps moving, disappearing, forming and pushed the balls to the next local minimum (store new position)
- 6: remove any balls which too close to each other balls and falling off the edge
- Repeat from Step 4

Examples


35
30
25
20
15
10
Mm
20
25
30
35
40
Mm

Further aspects

- smoothing and rescaling the output data

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  - smoothing resolution

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- smoothing and rescaling the output data
  - smoothing resolution
  - speed calibration

Further aspects

- smoothing and rescaling the output data
  - smoothing resolution
  - speed calibration
- comparison between Local Correlation tracking LCT and Balltracking

Sources

- http://www.astro.gla.ac.uk/users/hugh/balltrack/index.html
- http://www.aanda.org/articles/aa/abs/2004/34/aa0891/aa0891.html