Memory in a Contact Line

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Experiment Overview
- Can the shape of a water drop hold memory?
- Syringe pump infuses and withdraws same volume of water repeatedly, changing contact line shape
- Pictures taken once per cycle and analyzed

Apparatus
- DSLR camera positioned above
- Two pieces of acrylic or glass
- LEDs wrap around

Contact Line
- Interface between water and air in the channel is the contact line.

Steady State
- After many cycles, contact line reaches steady state where changes in shape are minimal.

Hydrophobicity and Contact Angle
- Acrylic is relatively hydrophobic, while glass is hydrophilic.
- This difference is roughly measured by the contact angle $\theta$ and might explain the materials' different contact line dynamics.

Diagnosing Return Point Memory
- Return Point Memory (RPM): Returning to a previous input restores the state of the system, unless a larger input is applied.
  1. "Train" contact line by repeating same volume amplitude for 200 cycles; system eventually reaches steady state
  2. Introduce smaller amplitude
  3. Repeat initial amplitude $\rightarrow$ expect steady state intact
  4. Introduce larger amplitude
  5. Repeat initial amplitude $\rightarrow$ expect steady state lost

Results
- On acrylic channel, contact line reaches nonzero steady state at high volume cycles.
- On glass channel, contact line only reaches zero steady state, even at higher volumes. This surprise prompted the search for other behaviors exhibited by glass.

Conclusions
- Behavior of contact line depends on channel material
- Contact line can store trained volume as info that can be retrieved later
- Contact line on glass may exhibit RPM, but need more rigorous tests

Contact Line

Contact line

Air

Water

5 mm

Steady State
- Smaller amplitude
- Zero steady state
- Larger amplitude
- Nonzero steady state

References:

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