Meniscus_cylinder Documentation

Release 0.1

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Contents

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Developer’s corner github.com project

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Version 0.1

Contents:

CHAPTER 1

Math

Problem

The Laplace law is:

$$\gamma\left(-\frac{r''}{(1+r'^2)^{3/2}}+\frac{1}{r(1+r'^2)^{1/2}}\right)=-\rho g z$$

for an interface $r(z)$, where z is the vertical coordinate and r the distance to the center of the cylinder (or pin).

Each length is made dimensionless by the capillary length:

$$\kappa^{-1}=\sqrt{\gamma/(\rho g)}$$

Thus, we have to solve:

$$\tilde{r}''=\tilde{z}(1+\tilde{r}'^2)^{3/2}+(1+\tilde{r}'^2)/\tilde{r}$$

To do so, we rewrite this 2nd order equation to two first order ODE:

$$\frac{d\tilde{r}}{d\tilde{z}}=R$$

$$\frac{dR}{d\tilde{z}}=\tilde{z}(1+R^2)^{3/2}+\frac{1+R^2}{\tilde{r}}$$

Analytic cases

CHAPTER 2

API

`profile.`**`calculate_meniscus`**(*tcl_position*, *pin_radius*, *theta=0*, *delta_z=0.5*, *num_point=1800*, *slope_cutoff=10000000.0*)

Calculate r(z).

Parameters

- **`tcl_position`** – z position of the TCL
- **`pin_radius`** – radius of the pin
- **`theta`** – contact angle, in degree
- **`delta_z`** – estimated height difference between TCL and flat interface.
- **`num_point`** – number of points for z
- **`slope_cutoff`** – maximum abs value for the slope r(z)

delta_z is positive in the wetting case

`profile.`**`meniscus_pin_ode`**(*r*, *z*)

returns ODE (dr/dz and d2r/dz2) for a meniscus on a pin

Parameters

- **`r`** – distance of the liquid-air interface to the pin center
- **`z`** – altitude

Returns numpy array

`profile.`**`shooter`**(*z_min*, *z_max*, *f*, **args*, ***kwargs*)

Shooting method to converge to z(infty) = 0

Parameters

- **`z_min`** – lower position of the TCL
- **`z_max`** – higher position of the TCL
- **`f`** – function returning the interface

- **`args`** – args of f
- **`kwargs`** – keyword args of f

Returns the result of f, at the converged position.

CHAPTER 3

Indices and tables

- genindex
- modindex
- search

Python Module Index

p

Index