

```
%PDE solutions
```

```
% Geometry
```

```
h = 0.1; % m
```

```
dh = 1e-4; % m
```

```
% Simulation Time
```

```
t_end = 100; %s
```

```
dt = 0.01; % s
```

```
xmesh= 0:dh:h;
```

```
tspan= 0:dt:t_end;
```

```
global R
```

```
R1 = [0.0005; 0.0001; 0.005];
```

```
enddt= linspace (0,0.01,100);
```

```
for i = 1:length(R1)
```

```
    R = R1(i);
```

```
    sol{i} = pdepe(0, @PDE, @PDE_IC, @PDE_BC, xmesh, tspan);
```

```
end
```

```
subplot (1,3,1);
```

```
plot
```

```
title('Liquid content as a function of z - R1 =  $5 \times 10^{-4}$  m')
```

```
xlabel('Radial Coordinate - z [m]')
```

```
ylabel('Liquid content -  $\phi$  ['])
```

```
grid on
```

```
hold on
```

```
subplot (1,3,2);
```

```
title('Liquid content as a function of z - R2 =  $1 \times 10^{-3}$  m')
```

```
xlabel('Radial Coordinate - z [m]')
```

```
ylabel('Liquid content -  $\phi$  ['])
```

```
grid on
```

```
hold on
```

```
subplot (1,3,3);
```

```
title('Liquid content as a function of z - R3 =  $5 \times 10^{-3}$  m')
```

```
xlabel('Radial Coordinate - z [m]')
```

```
ylabel('Liquid content -  $\phi$  ['])
```

```
grid on
```

```
hold on
```

```
% Constants and initial conditions
```

```
AF = 0.002; %  $m^2$ 
```

```
phi_0 = 0.36;
```

```
VI_F_t0 = AF * h * phi_0;
```

```
% Placeholder for drained liquid over time for each R
```

```
VI_D = cell(length(R1), 1);
```

```
% Plotting
```

```
hold off;
```

```
figure
```

```
title('Drained liquid over time for different R values');
```

```
xlabel('Time (s)');
```

```
ylabel('Drained Liquid Volume (m3)');
```

```
legend(arrayfun(@(R) sprintf('R = %g m', R), R_values, 'UniformOutput', false));
```

```
grid on;
```

```
function [c,f,s]= PDE(x,t,u,dudx)
```

```
global R
```

```
k1 = 0.0066;
```

```
k2 = 0.1610.5;
```

```
eta = 0.001; % Pa/s
```

```
gama = 0.04; % N/m
```

```
rho = 1000; % kg/m3
```

```
g = 9.81; % m/s2
```

```
eta = 0.001; % Pa s
```

```
c=1;
```

```
f = (((k1 * R2) / eta) * (rho * g * (u2)) - k2 * ((gama / (2 * R)) * u0.5 * dudx));
```

```
s=0;
```

```
end
```

```
% Initial conditions
```

```
function u0 = PDE_IC (x)
```

```
phi_0 = 0.36;
```

```
u0 = phi_0;
```

```
end
```

```
% Boundary conditions
```

```
function [pl, ql, pr, qr] = PDE_BC(xl, ul, xr, ur, t)
```

```
phi_H = 0.36; % phi at z = H
```

```
phi_z0 = 0; % phi at z = 0
```

```
pl = 0;
```

```
ql = 1;
```

```
pr = ur - phi_H;  
qr = 0;  
end
```