```
% Authors ~
    % Suyash Sardar

% Function Calculates the following ~
    % 1.Pressure Distribution across width
    % 2.Load Carrying Capacity of the bearing
    % 3.Shear Stress distribution in the bearing
    % 4.Friction Force
    % 5.Friction Coefficient

% Inputs ~
    %[n ~ Attitude Ratio]
    %[nodes ~ Number of Nodes]

% Outputs ~
    %[ h_bar ~ Height at various nodes]
    %[ p_bar ~ Pressure at various nodes]
    %[ tau_bar ~ Shear stress at various nodes]
    %[ Load_capacity ~ Load carrying capacity of the bearing]
    %[ Friction_force ~ Friction force generated in the bearing]
    %[ myu ~ Friction coefficient corresponding to the given load and
 friction force]

% Trial run for function
% [h_bar,dx,p_bar,tau_bar,Load_capacity,Friction_force,myu] =
 one_de(2,20);

function [h_bar,dx,p_bar,tau_bar,Load_capacity,Friction_force,myu] =
 one_de(n,nodes)

x_bar = linspace(0,1,nodes); % Discritizing x-direction in nx nodes
h_bar = n - (n-1)*x_bar;
flag = 0;
iter=0;
p_bar = zeros(1,nodes); % vector containing pressures at nx nodes
tau_bar = zeros(1,nodes);% vector containing shear stresses at nx
 nodes

% Following values are calculated to ease further computation.
dx = x_bar(2)-x_bar(1);
h_sqr = power(h_bar,2);
h_cub = power(h_bar,3);
dx_sqr = power(dx,2);
%dx_mat = ones(nx,1)*dx;


%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%%%%

% Calculating the Pressure Distribution at nx nodes
while(flag~=1)
    p_bar_prev = p_bar;
```

```
    iter = iter+ 1;

    % updating the pressure vector
    for i = 2 : (nodes-1)
        p_bar(i) = (dx_sqr/ (2 * h_cub(i))) * (((h_cub(i)* (p_bar(i+1)
+ p_bar(i-1))) / dx_sqr) +...
        (((p_bar(i+1) - p_bar(i-1)) * 3 * h_sqr(i) * (1-n)) /  (2 *
dx)) - (1-n));

    end

     % checking for convergence
    convergence = (abs(sum(p_bar))*dx - abs(sum(p_bar_prev))*dx) /
abs((sum(p_bar_prev))*dx);
    sprintf("iter: %d conv: %f",iter, convergence)

    if convergence < power(10,-4)
        flag = 1;
    end


  drawnow
  plot(p_bar);
  title([ 'PRESSURE DISTRIBUTION' '    ' 'for' '    ''Attitude
Ratio:' '    ' num2str(n)])
  ylabel('Non-dimentional pressure');
  xlabel('Non-dimentional width');

end
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%%%%%

% Calculating Load Carrying Capacity

    %W = dot(p_bar,dx_mat);

    %Using Trapeziodal Rule for Approximating Integration

    %temp = (p_bar(1) + p_bar(nxnodes)) * (dx/2);  % First and last
terms : f(a) * dx/2 + f(b) * dx/2
    %Load_capacity = temp + sum(p_bar(2:nxnodes-1))*dx; % center terms
    Load_capacity = sum(p_bar)* dx;



%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%%%%%

% Calculating the Shear Stress Distribution at nx nodes

for i = 1 : nodes

    % Forward Difference Method to Approximate the Derivative at Node
 1
```

```
    if (i == 1)
        tau_bar(i) = (((3 * h_bar(i)) * (p_bar(i+1) - p_bar(i)) / dx)
 + (1 / h_bar(i)));
    end

    % Central Difference Method to Approximate the central Derivatives
    if (i > 1 && i < nodes)
        tau_bar(i) = (((3 * h_bar(i)) * (p_bar(i+1) - p_bar(i-1)) /
 (2*dx)) + (1 / h_bar(i)));
    end

    % Backward Difference Method to Approximate the Derivative at node
 nx
    if (i == nodes)
        tau_bar(i) = (((3 * h_bar(i)) * (p_bar(i) - p_bar(i-1)) / dx)
 + (1 / h_bar(i)));
    end

end

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%%%%

% Calculating the Friction Force

% Using Trapezoidal Rule to Approximate the Integration

temp = (tau_bar(1) + tau_bar(nodes)) * (dx/2);  % First and last
 terms : f(a) * dx/2 + f(b) * dx/2
Friction_force = temp + sum(tau_bar(2:nodes-1))*dx; % center terms

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%%%%%

% Calculating the Friction Coefficient

myu = Friction_force / (6 * Load_capacity);


%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%%%%
    t_time=clock;
disp(['================================ ',date,'
 ================================'])
disp(['============= Steady State Analysis of Hydrodynamic Slider
 Bearings ============'])
disp(['================================ Time
 ',num2str(t_time(4)),':',num2str(t_time(5)),'
 ================================'])
sprintf("Load Carrying Capacity (Non-Dimensionalized Value) : %f",
 Load_capacity)
disp('**************************************************************************
sprintf("Friction Force Acting  (Non-Dimensionalized Value) : %f",
 Friction_force)
```

```
disp('*************************************************************************
sprintf("Coefficient of Friction (Non-Dimensionalized Value) : %f",
 myu)
disp('*************************************************************************



end
```

```
ans =

    "iter: 1 conv: Inf"


ans =

    "iter: 2 conv: 0.922089"


ans =

    "iter: 3 conv: 0.450854"


ans =

    "iter: 4 conv: 0.294787"


ans =

    "iter: 5 conv: 0.217213"


ans =

    "iter: 6 conv: 0.170917"


ans =

    "iter: 7 conv: 0.140203"


ans =

    "iter: 8 conv: 0.118361"


ans =

    "iter: 9 conv: 0.102047"
```

```
ans =

    "iter: 10 conv: 0.089405"

ans =

    "iter: 11 conv: 0.079327"

ans =

    "iter: 12 conv: 0.071108"

ans =

    "iter: 13 conv: 0.064278"

ans =

    "iter: 14 conv: 0.058516"

ans =

    "iter: 15 conv: 0.053589"

ans =

    "iter: 16 conv: 0.049330"

ans =

    "iter: 17 conv: 0.045611"

ans =

    "iter: 18 conv: 0.042337"

ans =

    "iter: 19 conv: 0.039432"

ans =

    "iter: 20 conv: 0.036837"
```

```
ans =

    "iter: 21 conv: 0.034507"

ans =

    "iter: 22 conv: 0.032401"

ans =

    "iter: 23 conv: 0.030490"

ans =

    "iter: 24 conv: 0.028748"

ans =

    "iter: 25 conv: 0.027153"

ans =

    "iter: 26 conv: 0.025689"

ans =

    "iter: 27 conv: 0.024339"

ans =

    "iter: 28 conv: 0.023092"

ans =

    "iter: 29 conv: 0.021936"

ans =

    "iter: 30 conv: 0.020862"

ans =
```

```
    "iter: 31 conv: 0.019862"

ans =

    "iter: 32 conv: 0.018928"

ans =

    "iter: 33 conv: 0.018056"

ans =

    "iter: 34 conv: 0.017238"

ans =

    "iter: 35 conv: 0.016471"

ans =

    "iter: 36 conv: 0.015750"

ans =

    "iter: 37 conv: 0.015071"

ans =

    "iter: 38 conv: 0.014431"

ans =

    "iter: 39 conv: 0.013827"

ans =

    "iter: 40 conv: 0.013256"

ans =

    "iter: 41 conv: 0.012716"

ans =
```

```
    "iter: 42 conv: 0.012205"

ans =

    "iter: 43 conv: 0.011720"

ans =

    "iter: 44 conv: 0.011259"

ans =

    "iter: 45 conv: 0.010822"

ans =

    "iter: 46 conv: 0.010406"

ans =

    "iter: 47 conv: 0.010010"

ans =

    "iter: 48 conv: 0.009633"

ans =

    "iter: 49 conv: 0.009274"

ans =

    "iter: 50 conv: 0.008931"

ans =

    "iter: 51 conv: 0.008604"

ans =

    "iter: 52 conv: 0.008292"
```

```
ans =

    "iter: 53 conv: 0.007993"

ans =

    "iter: 54 conv: 0.007708"

ans =

    "iter: 55 conv: 0.007434"

ans =

    "iter: 56 conv: 0.007173"

ans =

    "iter: 57 conv: 0.006922"

ans =

    "iter: 58 conv: 0.006682"

ans =

    "iter: 59 conv: 0.006451"

ans =

    "iter: 60 conv: 0.006230"

ans =

    "iter: 61 conv: 0.006018"

ans =

    "iter: 62 conv: 0.005815"

ans =

    "iter: 63 conv: 0.005619"
```

```
ans =

    "iter: 64 conv: 0.005431"

ans =

    "iter: 65 conv: 0.005250"

ans =

    "iter: 66 conv: 0.005076"

ans =

    "iter: 67 conv: 0.004909"

ans =

    "iter: 68 conv: 0.004748"

ans =

    "iter: 69 conv: 0.004593"

ans =

    "iter: 70 conv: 0.004444"

ans =

    "iter: 71 conv: 0.004301"

ans =

    "iter: 72 conv: 0.004162"

ans =

    "iter: 73 conv: 0.004029"

ans =

    "iter: 74 conv: 0.003900"
```

```
ans =

    "iter: 75 conv: 0.003776"

ans =

    "iter: 76 conv: 0.003656"

ans =

    "iter: 77 conv: 0.003541"

ans =

    "iter: 78 conv: 0.003430"

ans =

    "iter: 79 conv: 0.003322"

ans =

    "iter: 80 conv: 0.003218"

ans =

    "iter: 81 conv: 0.003118"

ans =

    "iter: 82 conv: 0.003021"

ans =

    "iter: 83 conv: 0.002928"

ans =

    "iter: 84 conv: 0.002837"

ans =
```

```
    "iter: 85 conv: 0.002750"

ans =

    "iter: 86 conv: 0.002666"

ans =

    "iter: 87 conv: 0.002584"

ans =

    "iter: 88 conv: 0.002505"

ans =

    "iter: 89 conv: 0.002429"

ans =

    "iter: 90 conv: 0.002355"

ans =

    "iter: 91 conv: 0.002284"

ans =

    "iter: 92 conv: 0.002214"

ans =

    "iter: 93 conv: 0.002148"

ans =

    "iter: 94 conv: 0.002083"

ans =

    "iter: 95 conv: 0.002020"

ans =
```

```
    "iter: 96 conv: 0.001960"

ans =

    "iter: 97 conv: 0.001901"

ans =

    "iter: 98 conv: 0.001844"

ans =

    "iter: 99 conv: 0.001789"

ans =

    "iter: 100 conv: 0.001736"

ans =

    "iter: 101 conv: 0.001684"

ans =

    "iter: 102 conv: 0.001635"

ans =

    "iter: 103 conv: 0.001586"

ans =

    "iter: 104 conv: 0.001539"

ans =

    "iter: 105 conv: 0.001494"

ans =

    "iter: 106 conv: 0.001450"
```

```
ans =

    "iter: 107 conv: 0.001407"

ans =

    "iter: 108 conv: 0.001366"

ans =

    "iter: 109 conv: 0.001326"

ans =

    "iter: 110 conv: 0.001287"

ans =

    "iter: 111 conv: 0.001249"

ans =

    "iter: 112 conv: 0.001213"

ans =

    "iter: 113 conv: 0.001177"

ans =

    "iter: 114 conv: 0.001143"

ans =

    "iter: 115 conv: 0.001109"

ans =

    "iter: 116 conv: 0.001077"

ans =

    "iter: 117 conv: 0.001046"
```

```
ans =

    "iter: 118 conv: 0.001015"

ans =

    "iter: 119 conv: 0.000986"

ans =

    "iter: 120 conv: 0.000957"

ans =

    "iter: 121 conv: 0.000930"

ans =

    "iter: 122 conv: 0.000903"

ans =

    "iter: 123 conv: 0.000877"

ans =

    "iter: 124 conv: 0.000851"

ans =

    "iter: 125 conv: 0.000827"

ans =

    "iter: 126 conv: 0.000803"

ans =

    "iter: 127 conv: 0.000780"

ans =

    "iter: 128 conv: 0.000757"
```

```
ans =

    "iter: 129 conv: 0.000736"

ans =

    "iter: 130 conv: 0.000714"

ans =

    "iter: 131 conv: 0.000694"

ans =

    "iter: 132 conv: 0.000674"

ans =

    "iter: 133 conv: 0.000655"

ans =

    "iter: 134 conv: 0.000636"

ans =

    "iter: 135 conv: 0.000618"

ans =

    "iter: 136 conv: 0.000600"

ans =

    "iter: 137 conv: 0.000583"

ans =

    "iter: 138 conv: 0.000566"

ans =
```

```
    "iter: 139 conv: 0.000550"

ans =

    "iter: 140 conv: 0.000534"

ans =

    "iter: 141 conv: 0.000519"

ans =

    "iter: 142 conv: 0.000504"

ans =

    "iter: 143 conv: 0.000490"

ans =

    "iter: 144 conv: 0.000476"

ans =

    "iter: 145 conv: 0.000462"

ans =

    "iter: 146 conv: 0.000449"

ans =

    "iter: 147 conv: 0.000436"

ans =

    "iter: 148 conv: 0.000424"

ans =

    "iter: 149 conv: 0.000412"

ans =
```

```
    "iter: 150 conv: 0.000400"

ans =

    "iter: 151 conv: 0.000389"

ans =

    "iter: 152 conv: 0.000378"

ans =

    "iter: 153 conv: 0.000367"

ans =

    "iter: 154 conv: 0.000357"

ans =

    "iter: 155 conv: 0.000347"

ans =

    "iter: 156 conv: 0.000337"

ans =

    "iter: 157 conv: 0.000327"

ans =

    "iter: 158 conv: 0.000318"

ans =

    "iter: 159 conv: 0.000309"

ans =

    "iter: 160 conv: 0.000300"
```

```
ans =

    "iter: 161 conv: 0.000292"

ans =

    "iter: 162 conv: 0.000283"

ans =

    "iter: 163 conv: 0.000275"

ans =

    "iter: 164 conv: 0.000268"

ans =

    "iter: 165 conv: 0.000260"

ans =

    "iter: 166 conv: 0.000253"

ans =

    "iter: 167 conv: 0.000245"

ans =

    "iter: 168 conv: 0.000239"

ans =

    "iter: 169 conv: 0.000232"

ans =

    "iter: 170 conv: 0.000225"

ans =

    "iter: 171 conv: 0.000219"
```

```
ans =

    "iter: 172 conv: 0.000213"

ans =

    "iter: 173 conv: 0.000207"

ans =

    "iter: 174 conv: 0.000201"

ans =

    "iter: 175 conv: 0.000195"

ans =

    "iter: 176 conv: 0.000190"

ans =

    "iter: 177 conv: 0.000184"

ans =

    "iter: 178 conv: 0.000179"

ans =

    "iter: 179 conv: 0.000174"

ans =

    "iter: 180 conv: 0.000169"

ans =

    "iter: 181 conv: 0.000164"

ans =

    "iter: 182 conv: 0.000160"
```

```
ans =

    "iter: 183 conv: 0.000155"

ans =

    "iter: 184 conv: 0.000151"

ans =

    "iter: 185 conv: 0.000147"

ans =

    "iter: 186 conv: 0.000143"

ans =

    "iter: 187 conv: 0.000138"

ans =

    "iter: 188 conv: 0.000135"

ans =

    "iter: 189 conv: 0.000131"

ans =

    "iter: 190 conv: 0.000127"

ans =

    "iter: 191 conv: 0.000124"

ans =

    "iter: 192 conv: 0.000120"

ans =
```

```
    "iter: 193 conv: 0.000117"

ans =

    "iter: 194 conv: 0.000113"

ans =

    "iter: 195 conv: 0.000110"

ans =

    "iter: 196 conv: 0.000107"

ans =

    "iter: 197 conv: 0.000104"

ans =

    "iter: 198 conv: 0.000101"

ans =

    "iter: 199 conv: 0.000098"

================================= 05-May-2018
 ================================
============= Steady State Analysis of Hydrodynamic Slider Bearings
 ============
================================= Time 1:18
 =================================

ans =

    "Load Carrying Capacity (Non-Dimensionalized Value) : 0.026295"

**************************************************************************

ans =

    "Friction Force Acting  (Non-Dimensionalized Value) : 0.772205"

**************************************************************************

ans =

    "Coefficient of Friction (Non-Dimensionalized Value) : 4.894533"
```

```
**************************************************************************
h_bar =
  Columns 1 through 7
    2.0000    1.9474    1.8947    1.8421    1.7895    1.7368    1.6842
  Columns 8 through 14
    1.6316    1.5789    1.5263    1.4737    1.4211    1.3684    1.3158
  Columns 15 through 20
    1.2632    1.2105    1.1579    1.1053    1.0526    1.0000

dx =
    0.0526

p_bar =
  Columns 1 through 7
         0    0.0044    0.0087    0.0130    0.0172    0.0213    0.0253
  Columns 8 through 14
    0.0290    0.0325    0.0355    0.0381    0.0401    0.0413    0.0415
  Columns 15 through 20
    0.0404    0.0377    0.0330    0.0256    0.0150         0

tau_bar =
  Columns 1 through 7
    0.9976    0.9969    0.9945    0.9902    0.9837    0.9746    0.9625
  Columns 8 through 14
    0.9467    0.9266    0.9014    0.8701    0.8315    0.7843    0.7265
  Columns 15 through 20
    0.6561    0.5703    0.4656    0.3376    0.1808    0.1468

Load_capacity =
```

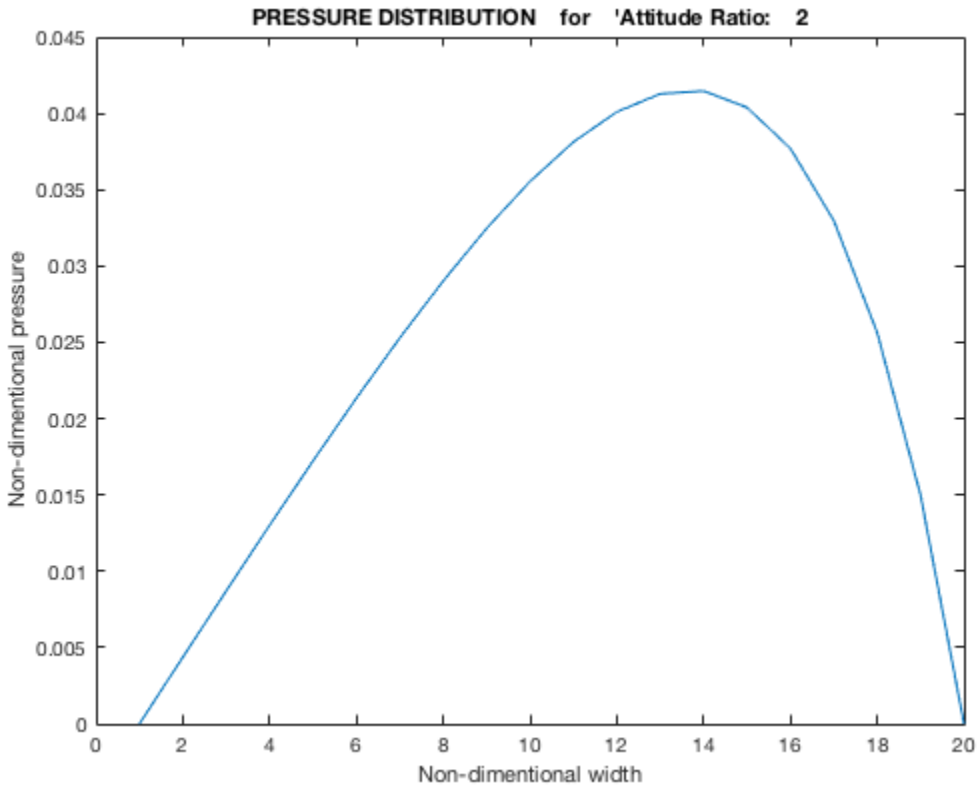
```
    0.0263

Friction_force =

    0.7722

myu =

    4.8945
```



Published with MATLAB® R2017b