

A computational study of mechanical bidomain model in durotaxis

Parameters

$N = 101$ (No of nodes)
 $L = 0.005$ m (Length of domain)
 $\nu = 1000$ Pa (Intracellular modulus)
 $\mu_{\text{zero}} = 1000$ Pa (Extracellular modulus)
 $K = 50000000000$ Pa/m² (Stiffness)
 $T = 200$ Pa (Tension)

Code and Results

```

N = 101;
L = 0.005; %0.005m
g = 0; %1000000; %100000 Pa/m
mu_zero = 1000; %1000 Pa
nu = 1000; %1000 Pa
K = 50000000000; %50GPa/m2
T = 200; %200Pa
w = zeros(N,1); %Extracellular displacement
u = zeros(N,1); %Intracellular displacement
x = zeros(N,1); %x position, useful when plotting
delta = (2*L)/(N-1); %Spacing along x direction
iterations = 100;
for i = 1:N
    x(i) = L*(2*(i-1)/(N-1)-1);
    mu(i) = mu_zero + g*x(i);
end
for k = 1:iterations
    for i = 2:(N-1)
        a(i) = 4*mu(i)*(w(i+1)+w(i-1))+(mu(i+1)-mu(i-1))*(w(i+1)-w(i-1));
        b(i) = 4*nu*(u(i+1)+u(i-1));
        A(i) = 8*mu(i) + K*delta*delta;
        C = 8*nu + K*delta*delta;
        B = K*delta*delta;
        u(i) = (a(i)*B + A(i)*b(i))/(A(i)*C - B*B);
        w(i) = (a(i)/A(i)) + (B/A(i))*((a(i)*B + A(i)*b(i))/(A(i)*C - B*B));
    end
    %Apply Boundary Conditions
    u(1) = u(2) + (T*delta/(4*nu));
    w(1) = w(2);
    u(N) = u(N-1) - (T*delta/(4*nu));
    w(N) = w(N-1);
end
for i = 1:N
    h(i) = u(i)-w(i);
end
plot(x,h) %if you want plot with x in mm, use plot(x*1000,h)
xlabel('x');
ylabel('u-w');
title('Difference between extracellular and intracellular displacement');
    
```

SOR Iterations against time

Iterations	Time (seconds)	Relaxation Value
100	0.000535	1.94
1000	0.0055	1.87
10000	0.0541	1.95
100000	0.5556	1.92
1000000	5.4486	1.91

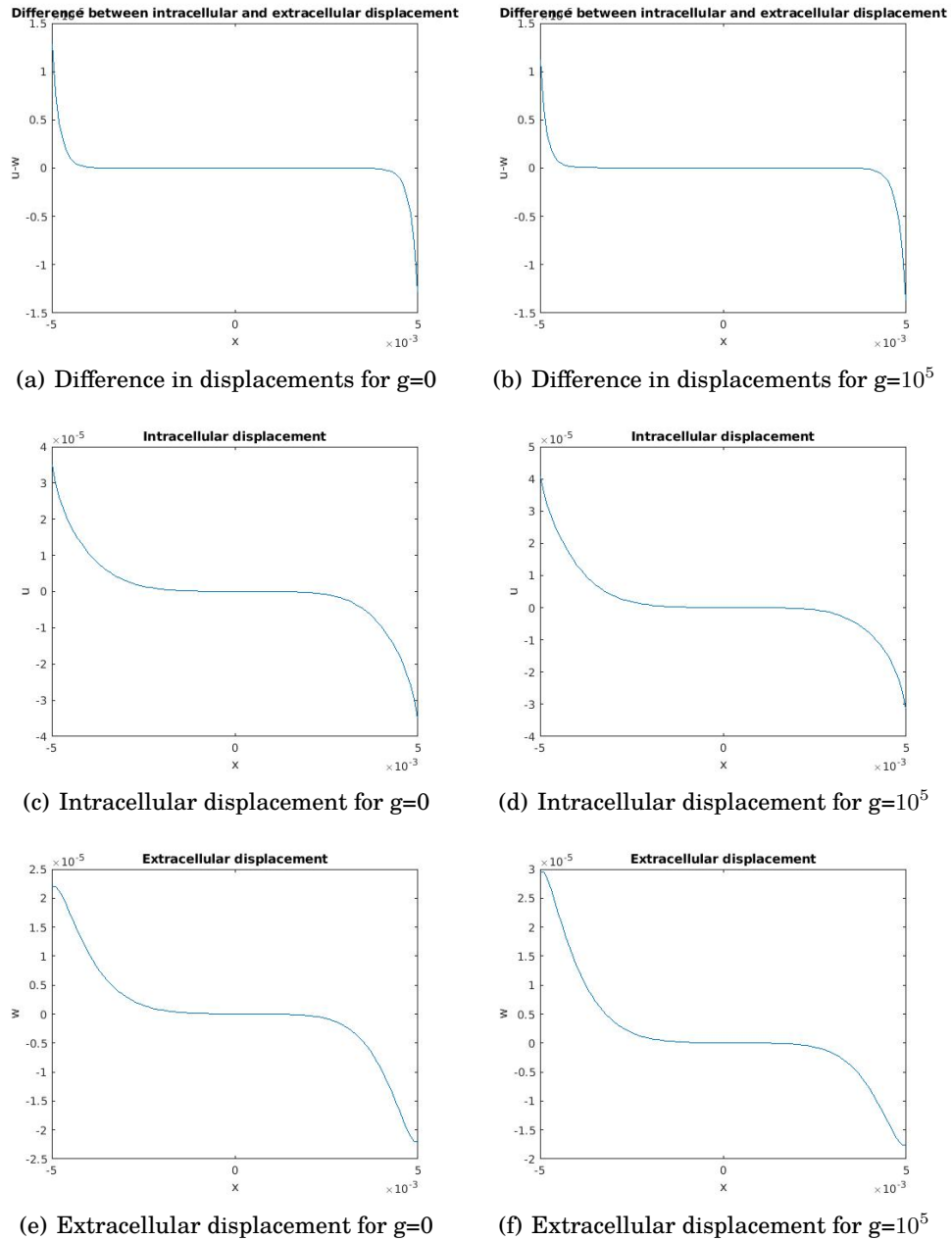


Figure 1: Comparison of results for $g=0$ and $g=10^5$ Pa/m (Iteration: 100). Elapsed time is 0.320051 seconds.

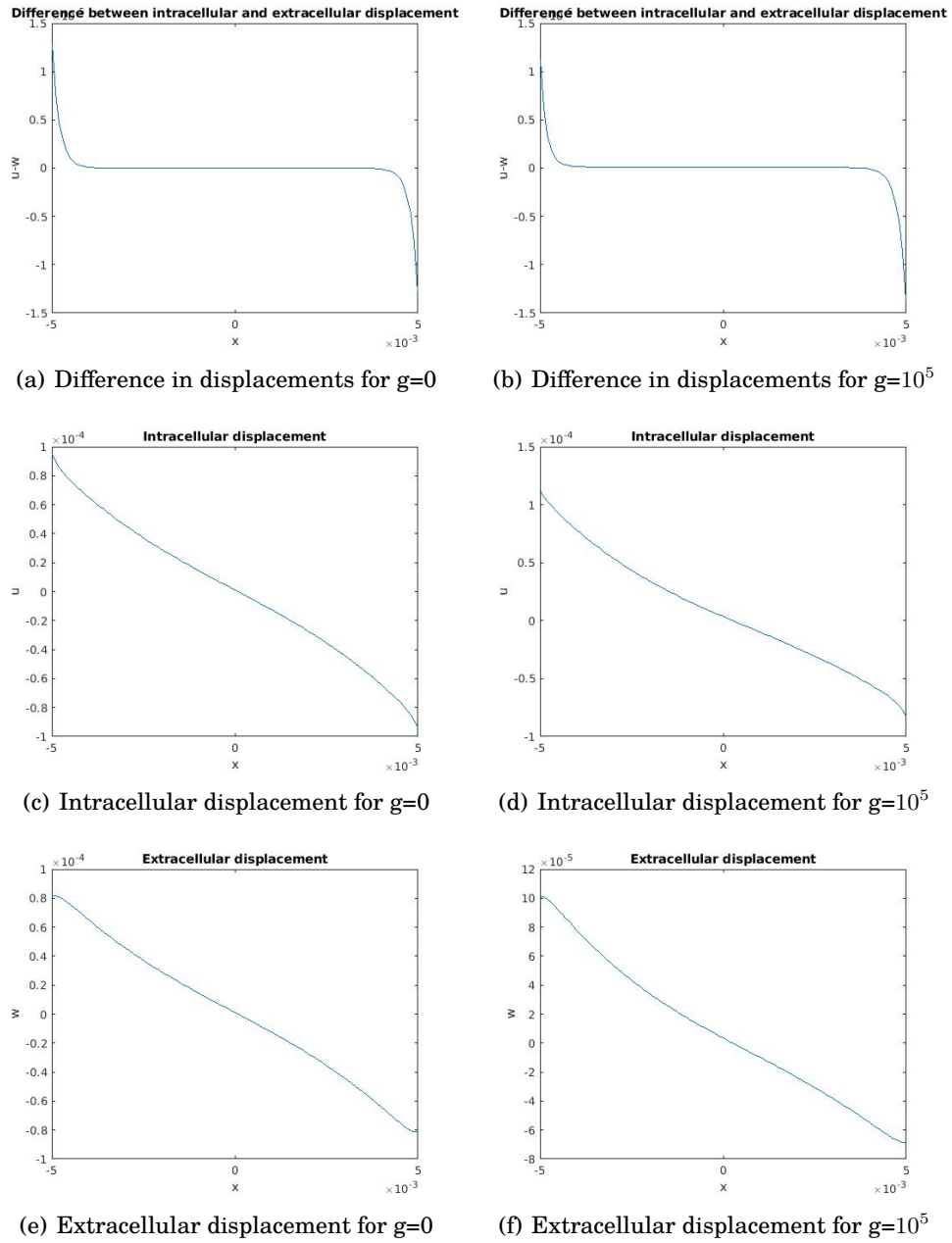


Figure 2: Comparison of results for $g=0$ and $g=10^5$ Pa/m (Iteration: 1000). Elapsed time is 0.366209 seconds.

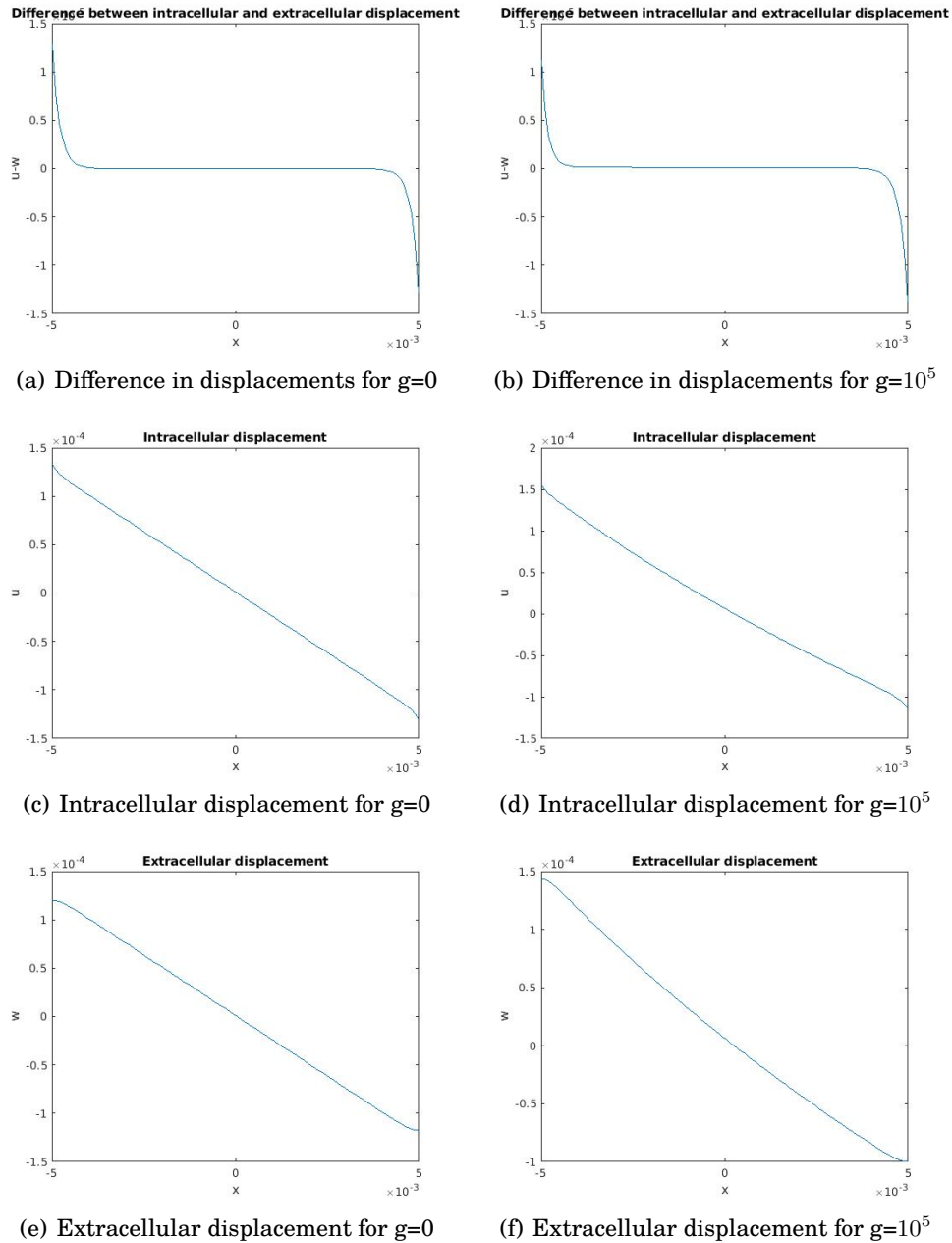


Figure 3: Comparison of results for $g=0$ and $g=10^5$ Pa/m (Iteration: 10000). Elapsed time is 0.414921 seconds.

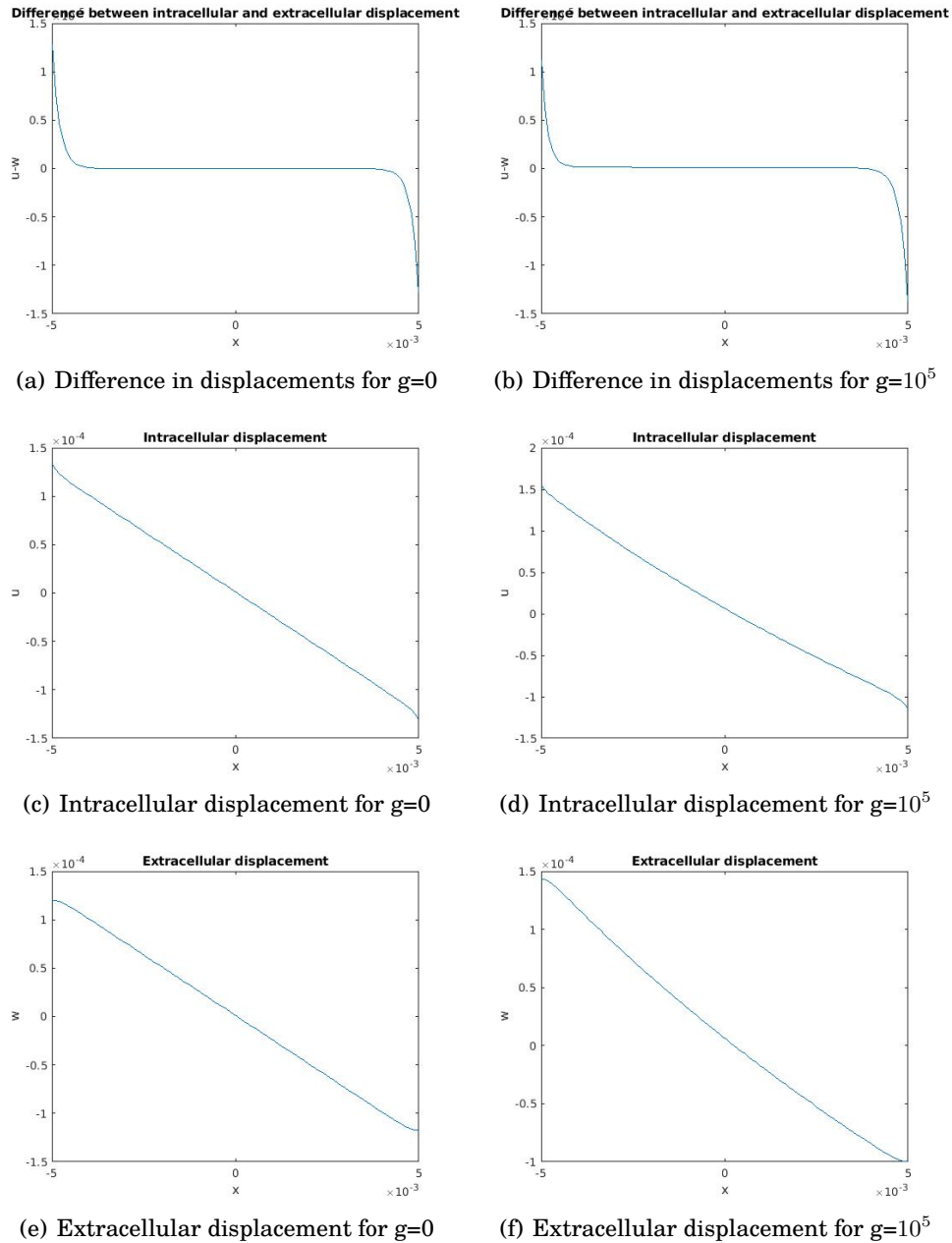


Figure 4: Comparison of results for $g=0$ and $g=10^5$ Pa/m (Iteration: 100000). Elapsed time is 0.772543 seconds.

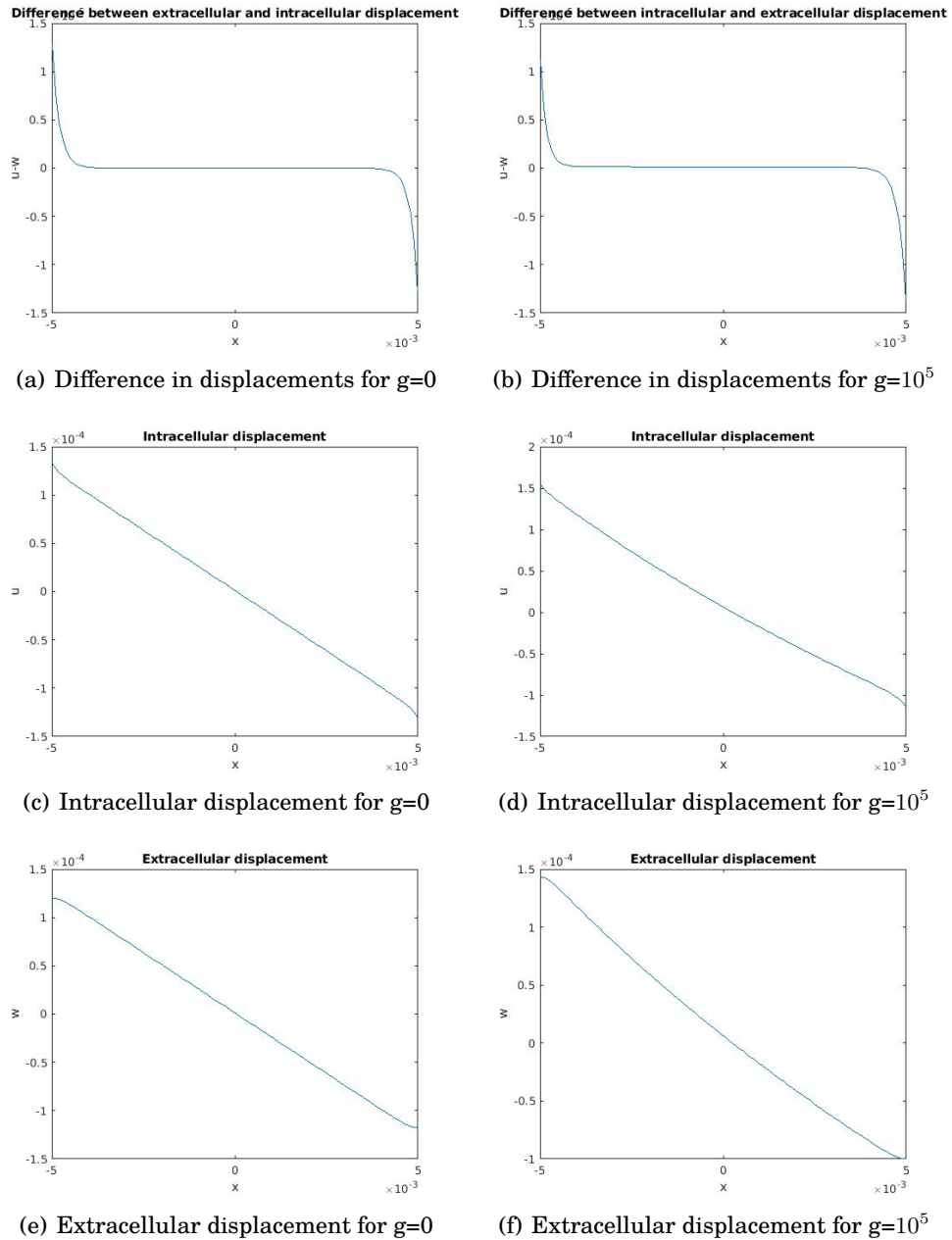


Figure 5: Comparison of results for $g=0$ and $g=10^5$ Pa/m (Iteration: 1000000). Elapsed time is 6.259795 seconds.