MAT188: Laboratory #8: Parameterization

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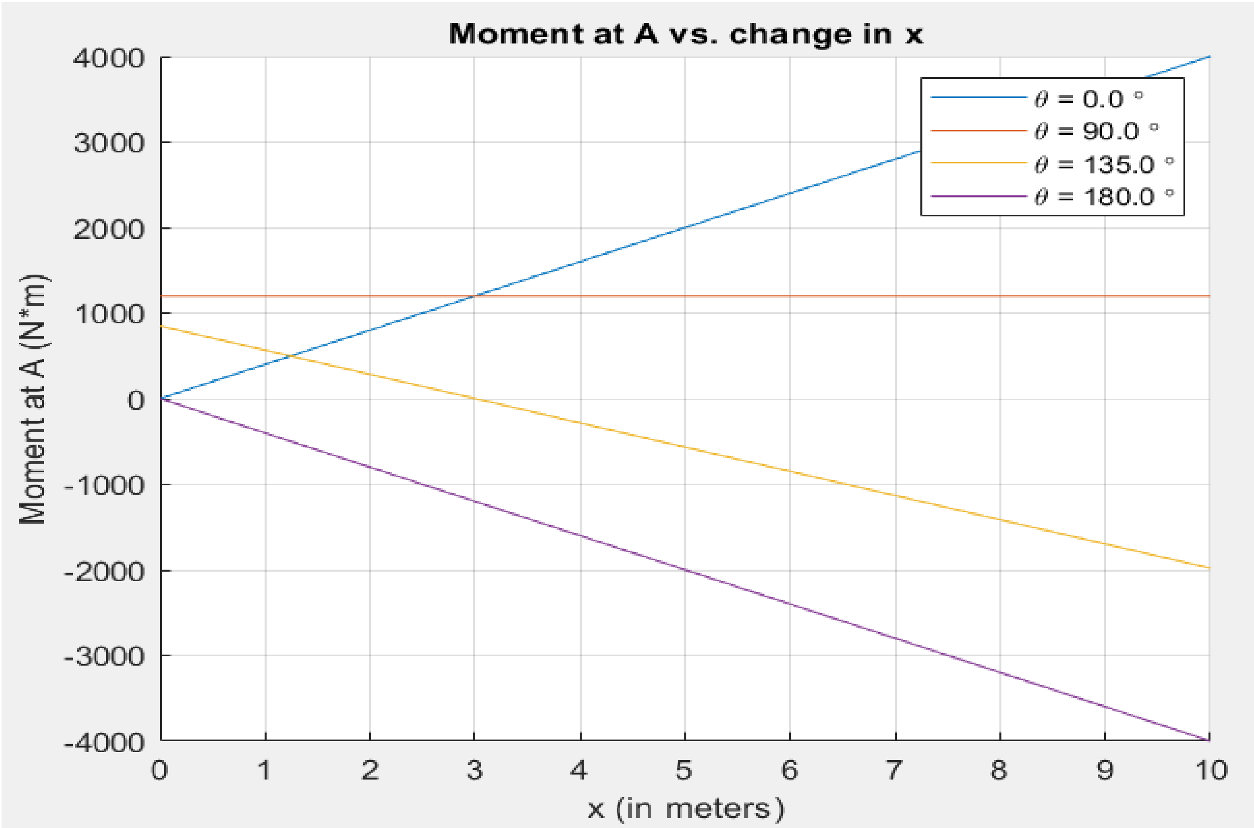
Part 1: *Understand how the moment at A depends on the parameters x and θ by creating two 2D figures.*

Write a script to calculate the moment at A for each combination of *x* and θ in the range given above, using the expression you determined in your preparation exercise.

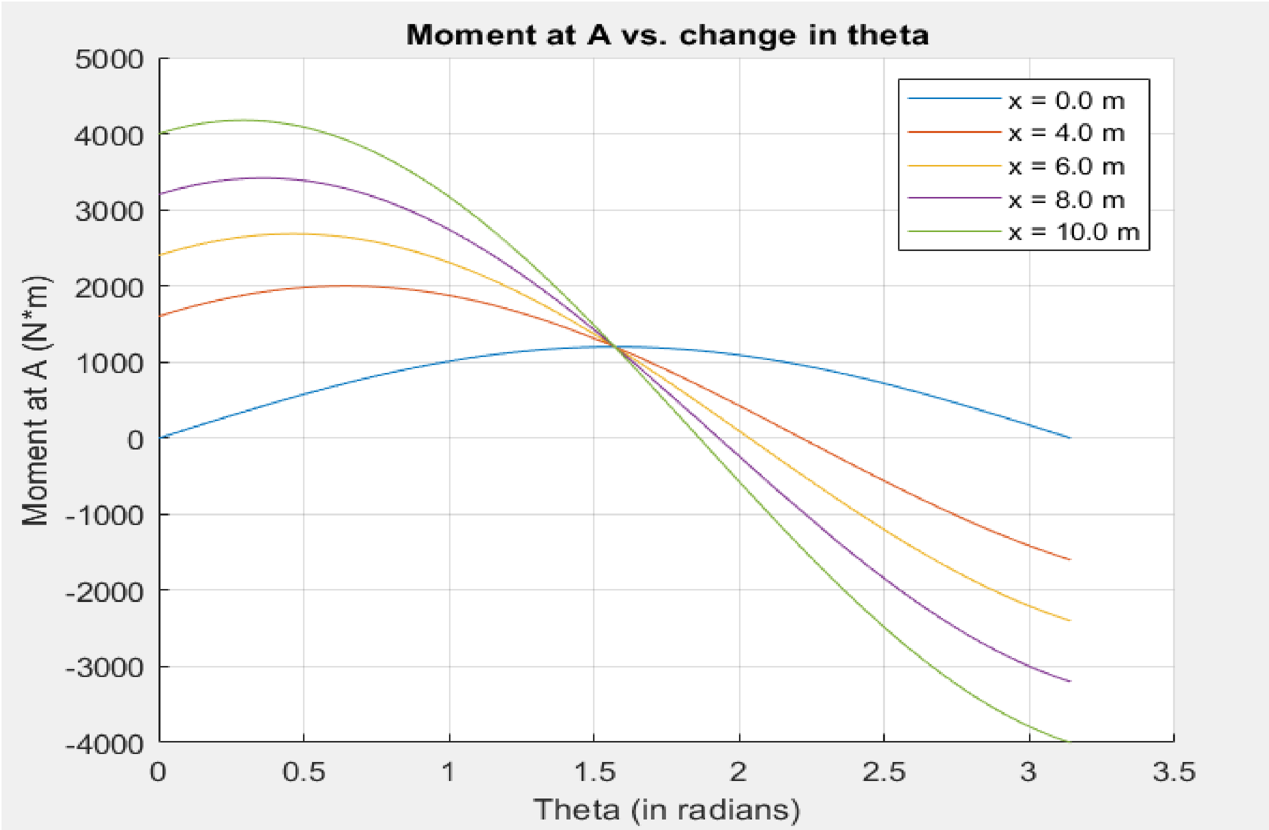
```
M=[];
F=400;

m=linspace(0,pi,401);
x=linspace(0,10,501);

for i_m=1:length(m)
 for i_x=1:length(x)

M(i_m,i_x)=((F*sin(m(i_m))*3)+(F*cos(m(i_m))*(x(i_x))));
 end
end
M; % Output the result Code for PLOT #1

grid on
hold on

%Code for PLOT #1
plot(x,M(1,:));
plot(x,M(201,:));
plot(x,M(301,:));
plot(x,M(401,:));

label1=sprintf('%s = %2.1f
%s','\theta',180*m(1)/pi,'\circ');
label2=sprintf('%s = %2.1f
%s','\theta',180*m(201)/pi,'\circ');
label3=sprintf('%s = %2.1f
%s','\theta',180*m(301)/pi,'\circ');
label4=sprintf('%s = %2.1f
%s','\theta',180*m(401)/pi,'\circ');
legend(label1,label2,label3,label4);

xlabel('x (in meters)');
ylabel('Moment at A (N*m)');
title('Moment at A vs. change in x');
```

PLOT #1




```
%Code for PLOT #2
plot(m,M(:,1));
plot(m,M(:,201));
plot(m,M(:,301));
plot(m,M(:,401));
plot(m,M(:,501));

label1=sprintf('x = %2.1f m',x(1));
label2=sprintf('x = %2.1f m',x(201));
label3=sprintf('x = %2.1f m',x(301));
label4=sprintf('x = %2.1f m',x(401));
label5=sprintf('x = %2.1f m',x(501));
legend(label1,label2,label3,label4,label5);

xlabel('Theta (in radians)');
ylabel('Moment at A (N*m)');
title('Moment at A vs. change in theta');
```

PLOT #2


Moment at A vs. change in theta
5000
4000
3000
2000
1000
0
-1000
-2000
-3000
-4000
Moment at A (N*m)
0
0.5
1
1.5
2
2.5
3
3.5
Theta (in radians)
x = 0.0 m
x = 4.0 m
x = 6.0 m
x = 8.0 m
x = 10.0 m

Part 2: *Analyze your figures and explain why you are confident that your calculations and procedure are correct. Hint*: Start by considering the results for the extreme or unique cases (such as x=0 m, x=10 m, ***others?***)

I am confident that my calculations and procedures are correct because at the extreme cases such as x=0 m I get the lowest Moment at A. This is because based on the formula:
`F*cos(m(i_m))*(x(i_x))`

When x = 0 m then the moment in the x direction is 0. Therefore, the final value of Moment is only dependent on:
`F*sin(m(i_m))*3`

At the other extreme case of x = 10m, the moment is also the largest, which I know is also correct based on the same formulas where d = 10m and therefore it would yield the largest answer since:
`F*cos(m(i_m))*(x(i_x))` is the largest when x = 10m.

For plot 2, I am confident that my calculations and procedures are correct because as theta increases, it follows a sinusoidal pattern. At the extreme case of θ=0°:
`F*sin(m(i_m))*3 = 0` Nm
And therefore, the moment is solely dependent on:
`F*cos(m(i_m))*(x(i_x))`
And this is why as x increases from 0m to 10m, the moment also increases at set intervals. The same can be said about the other extreme where θ=180° and the answers are flipped to be negative.

Edge and Special Case Considerations
1) Do your results make sense when θ=90° as x varies? What happens?

My results make sense when θ=90° as x varies because the moment stays constant. This is because F*cos(m(i_m))*(x(i_x)) = 0 Nm because cos 90° = 0 and therefore, the varying of the x component yields no changes to the Moment at A because F*sin(m(i_m))*3 is not dependent on the x component.

2) Do your results make sense when x=0 as θ varies? What happens?

My results make sense when x=0 as θ varies because F*cos(m(i_m))*(x(i_x)) = 0 Nm and therefore the Moment at A is dependent on F*sin(m(i_m))*3 which is independent of the x component.

3) As x increases, do the results make sense? Pay particular attention to the location of the maximum moment. If $x \to \infty$, from your understanding of the physical problem where would you expect the maximum moment to occur? Do your results indicate that this will happen?

The maximum moment would occur at an angle of 0 degrees as x approaches larger values. This result does make sense since the distance from point A to the horizontal component of the force would be so great that the vertical force would become insignificant. This can be seen in graph 1, where the moment when theta is 0 degrees has the highest value when the vertical distance (x) is 10 m.

Interpreting Results

1) If you wanted to have the moment at *A* be completely independent of x, what would you do based on your results?

I would set θ=90° this is because (F*cos(m(i_m))*(x(i_x)) = 0 Nm because cos 90° = 0. Now the Moment of A is dependent on F*sin(m(i_m))*3 which is independent of the x component.

2) If you wanted to have the moment of *A* be zero, what would you do based on your results?

I would set θ=0° this is because F*sin(m(i_m))*3 = 0 Nm because sin 0° = 0. Also, I would set the x = 0m because (F*cos(m(i_m))*(x(i_x)) = 0 Nm if x = 0 m. Therefore, the moment at A would be M(i_m,i_x)=((F*sin(m(i_m))*3)+(F*cos(m(i_m))*(x(i_x)))) = 0 Nm.