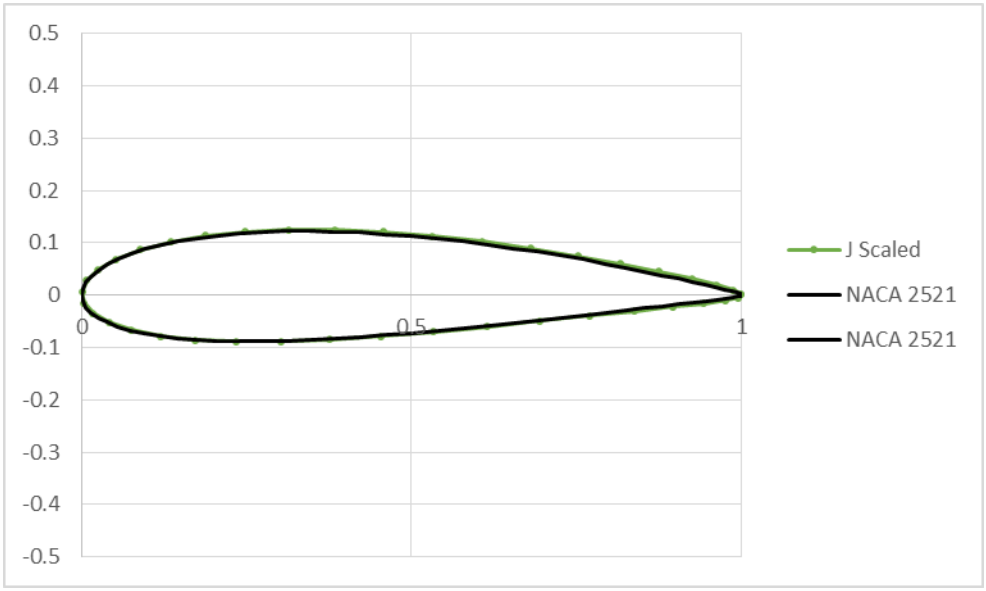
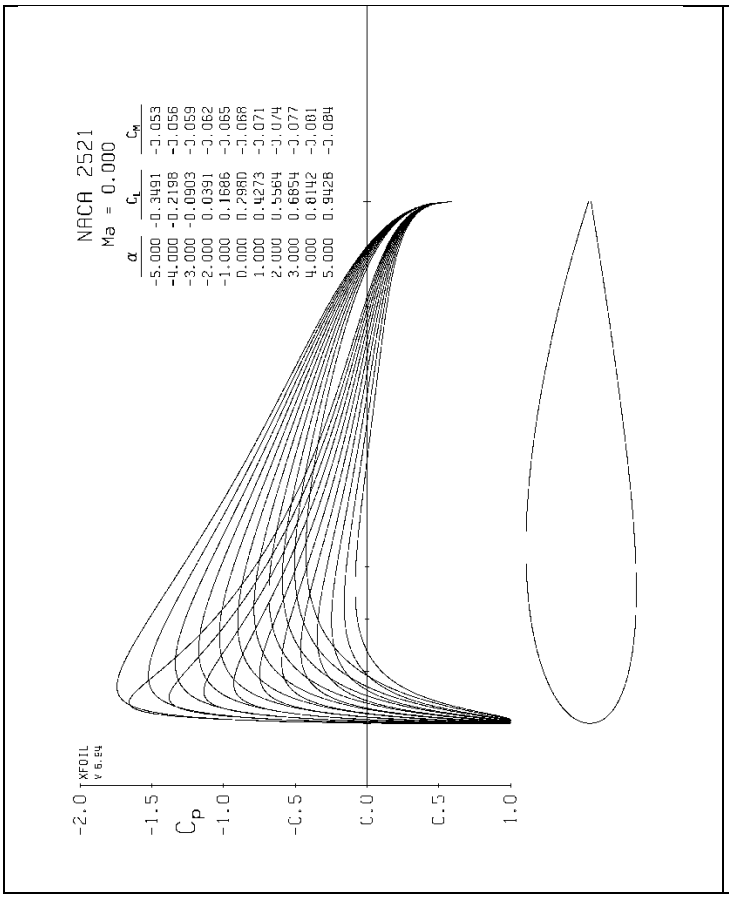
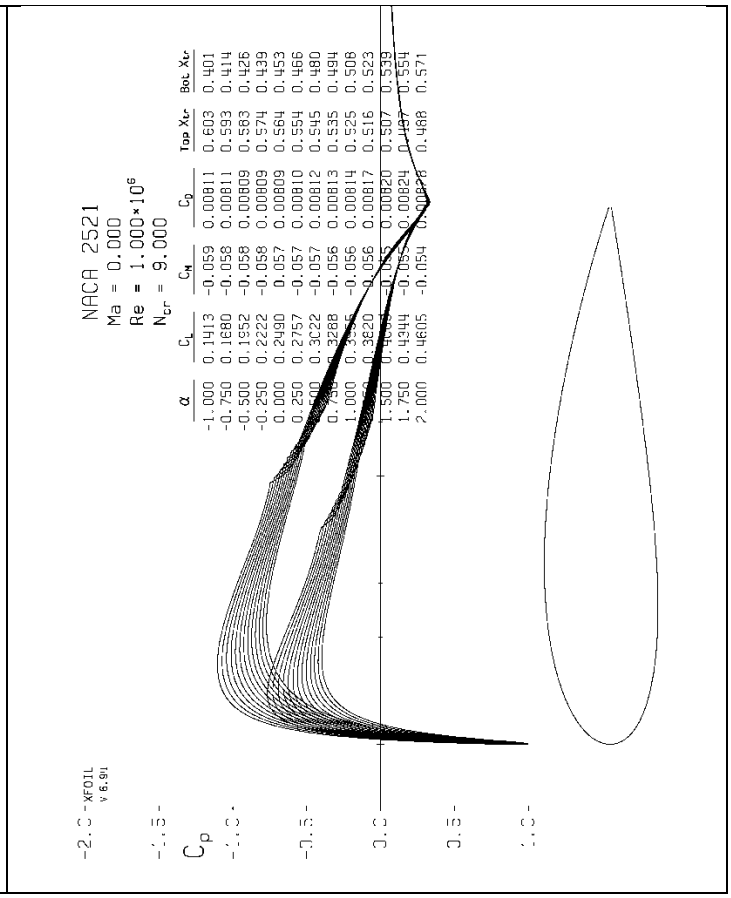
Homework #2 Solution: NACA 2521



delta rad	alfa rad	m	C1^2
2.775074	0	0.12	0.6724





Model	Cl_α [1/deg]	X_{ac}	$Cm_{c/4}$ (a=0)	α_{zl}	Cl_0
NACA 460	0.085	23%	-0.04	-2	0.19
Joukowski	0.123	26.2%	-0.067	-2.5	0.308
XFOIL inviscid	0.1293	27.3%	-0.065	-2.3	0.298
XFOIL viscous	0.1065	23.6%	-0.057	-2.3	0.249

Experimental and XFOIL

$x_{ac} = 0.25 - dCl / dCm$

Finite difference method for determining derivatives.

Joukowski

$x_{ac} = \frac{1}{4} + \frac{\epsilon^2}{2}$

Max camber from fitted curve, $m = 0.12\sin(2.775) \approx 0.043$. $f / c \approx \frac{2m}{4c} = 0.0215$

Zero lift angle is $-2\frac{f}{c} = -0.043$ radians, which is about -2.5 degrees

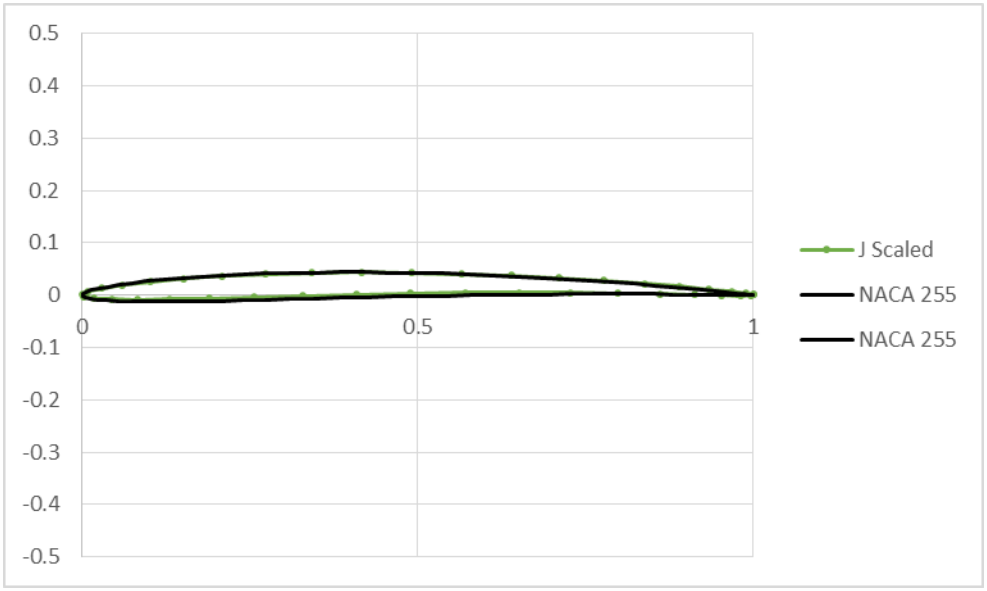
Moment is $Cm_{0.25c} \approx -\pi\frac{f}{c}$, which is about -0.067

Cl0 is lift slope multiplied by zero lift angle. This is about 0.3

Comments

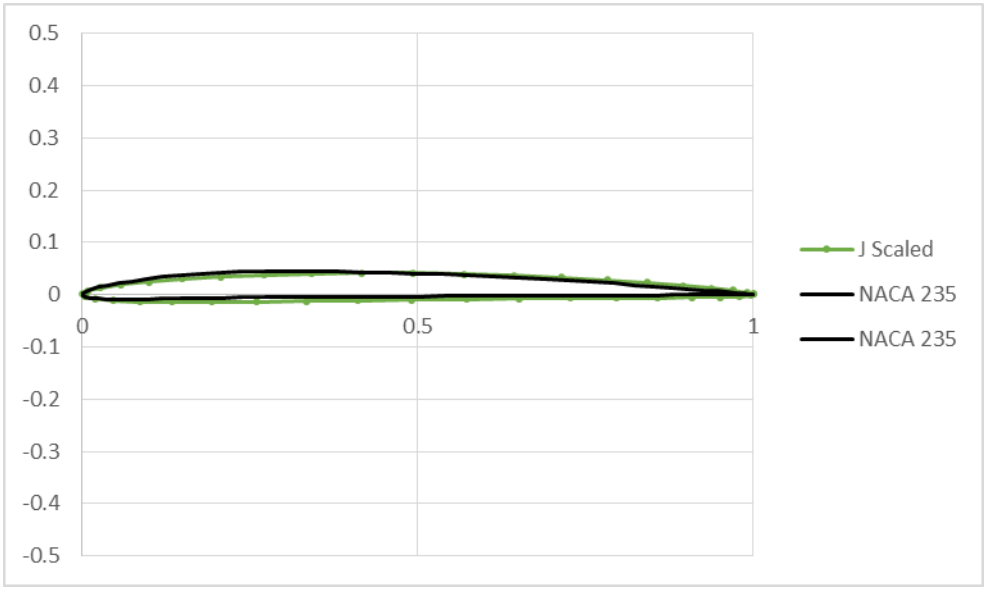
The results are grouped into inviscid and viscous results. XFOIL inviscid resembles Joukowski. XFOIL viscous resembles the experimental data.

NACA 2506



delta rad	alfa rad	m	C1^2
1.989675	0	0.05	0.9216

NACA 2306



delta rad	alfa rad	m	C1^2
2.059489	0	0.035	0.9025

The process of generating the full matrix of values matches that presented for the 2521.