Transonic Tunnel Experiment C_p variation along chord length at varying angle of attack

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Aim

To plot C_p variation along the chord length for fixed angles of attack, ranging from $-10°$ to $10°$.

Experimental Setup and Apparatus Required

Transonic wind tunnel, NACA 0012 airfoil with pressure ports fitted on it, scanner valve pressure transducer.

The flow field and hence the flow variables like pressure around an airfoil depend on the angle of attack of the airfoil. Lift depends on the pressure distribution. To analyze the effect of angle of attack on life we measure the pressure values on the top and bottom surface of the airfoil for different angles of attack. We use the NACA 0012 airfoil which is symmetric.

Observations

We measure the pressure values at each of the pressure ports on the airfoil during the experiment (pressures are gauge, measured in psi). The data is presented in the table as follows:

$\alpha = 10°$	$\alpha = 5°$	$\alpha = 0°$	$\alpha = -5°$	$\alpha = -10°$
-3.655	-3.794	-3.772	-3.666	-3.557
-6.288	-6.978	-4.845	-3.178	-2.521
-5.942	-6.807	-4.964	-3.486	-2.782
-5.617	-5.174	-4.417	-3.529	-2.986
-4.822	-4.805	-4.315	-3.664	-3.231
-4.301	-4.139	-3.831	-3.491	-3.266
-4.027	-3.941	-3.742	-3.532	-3.320
-3.711	-3.613	-3.541	-3.403	-3.273
-1.302	-1.190	-1.183	-1.169	-1.122
-3.339	-3.183	-3.208	-3.216	-3.153
-3.245	-2.951	-3.057	-3.180	-3.150
-0.684	-0.883	-2.723	-6.796	-8.158
-1.152	-1.837	-3.649	-6.851	-8.400
-1.161	-2.315	-3.747	-6.504	-7.732
-2.273	-2.820	-3.981	-5.291	-5.501
-3.940	-2.305	-0.206	-0.225	-0.768

Table 1: Gauge pressure readings at the pressure ports on the airfoil

Results

We plot the variation of C_p along chord length x/c for different angles of attack and obtain the following plots:
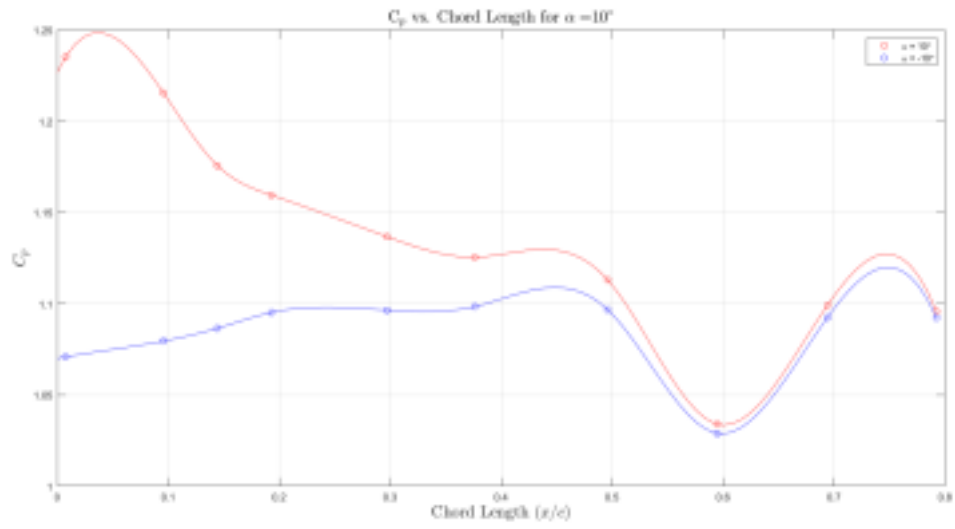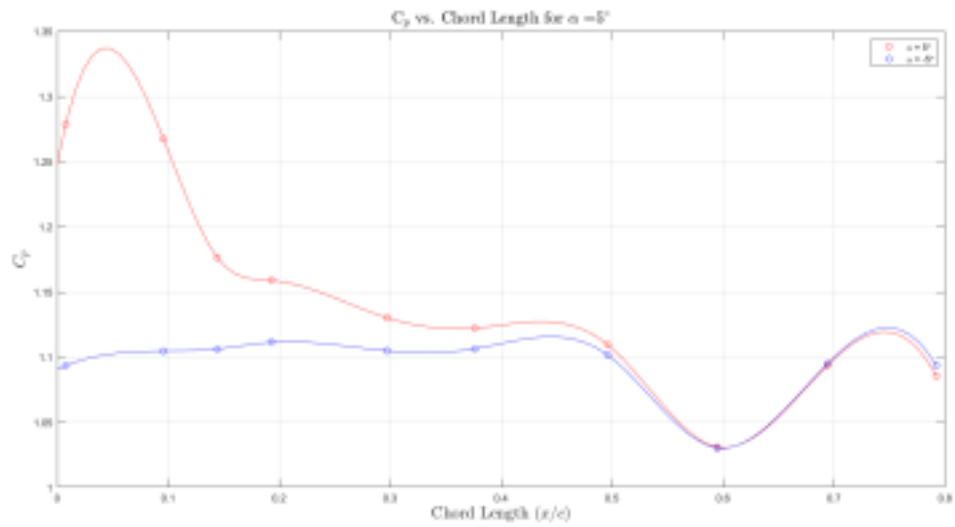
Figure 2: C_p variation for $\alpha = 10°$

Figure 3: C_p variation for $\alpha = 5°$

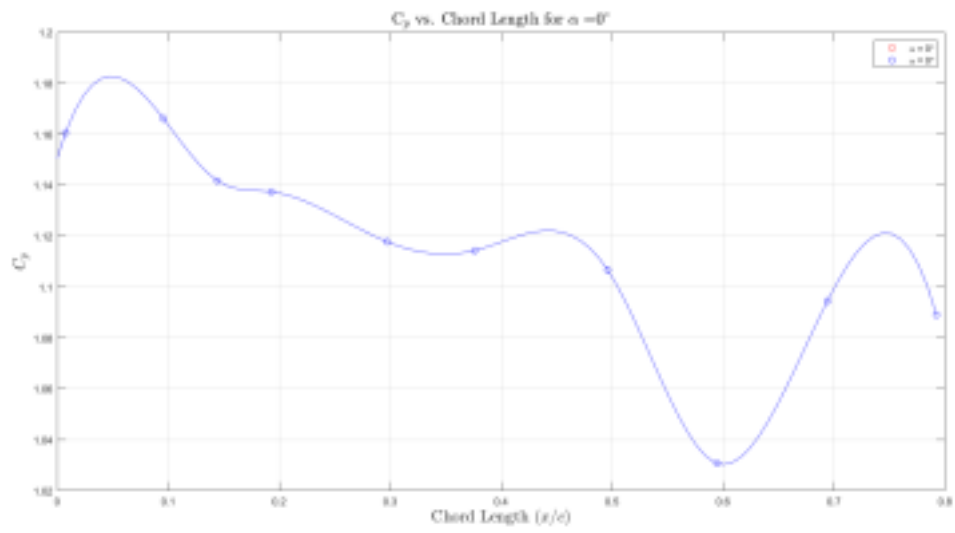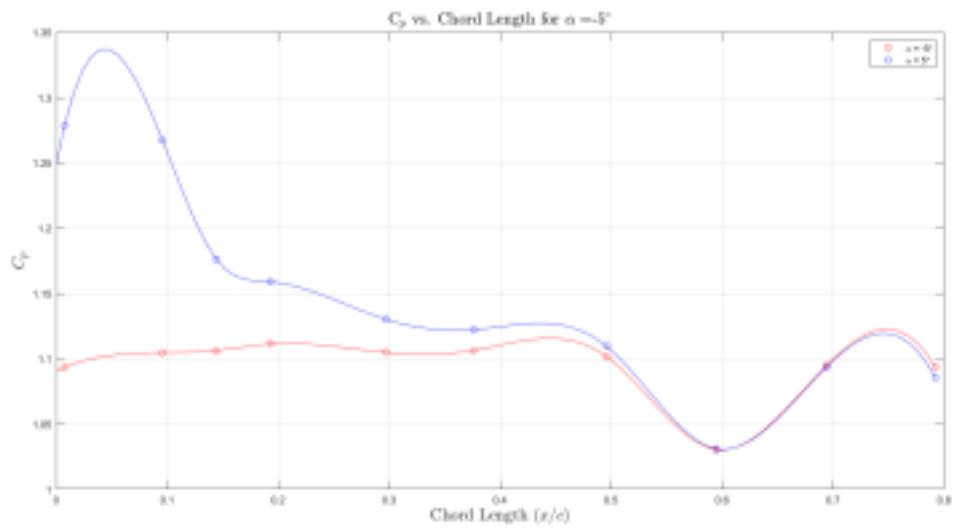Figure 4: C_p variation for $\alpha = 0°$
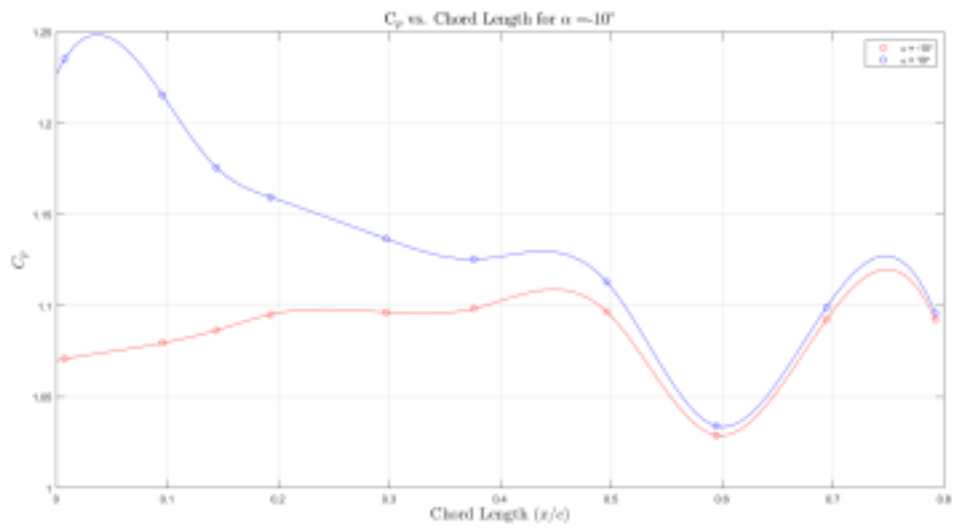
Figure 5: C_p variation for $\alpha = -5°$

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Figure 6: C_p variation for $\alpha = -10°$

Conclusions

We observe that the plots of C_p vs chord length for $\alpha = 5°$ and $-5°$ are the inverse of each other, *i.e.* C_p values are exchanged for the lower and upper surfaces. Similar is the case for $\alpha = 10°$ and $-10°$.