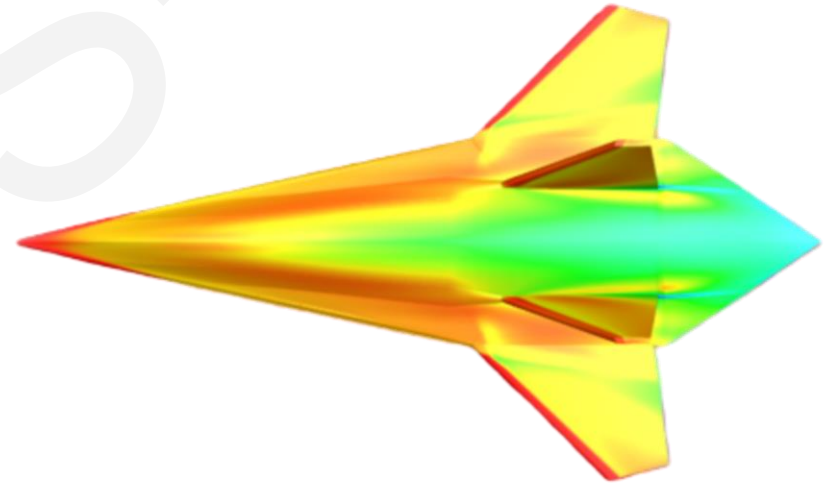


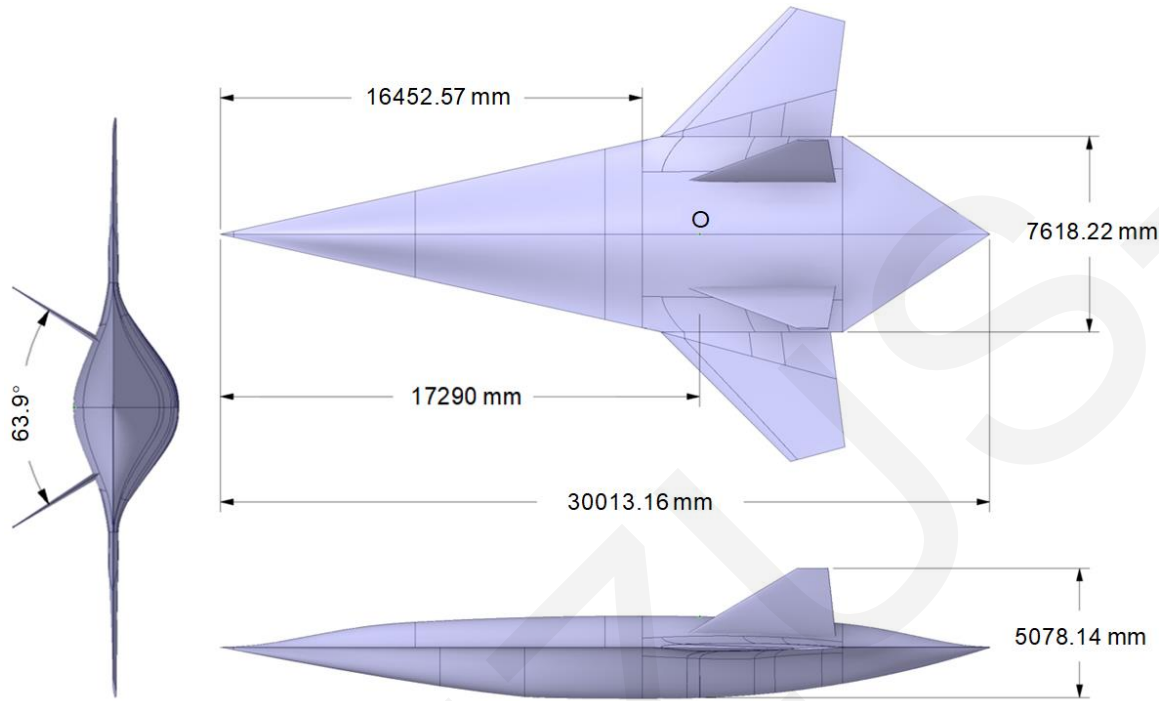
Design and aerodynamic performance of a wide-speed-range morphing aircraft with horizontal takeoff

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Design of the horizontal takeoff wide-speed-range morphing aircraft



Parameter	Value
Length (mm)	30013.16
Width (mm)	17731.26
Height (mm)	5078.14
Wingtip-root ratio	3.12
Leading edge swept-back angle (°)	30, 45, 60
Tail height (m)	2.675
Designed Mach number, Ma	0.3–7
Half cone angle of conical flow field (°)	12.5

The proposed aircraft must be able to take off and land horizontally from the runway. To achieve optimal flying performance across a broad range of speeds, the configuration must meet subsonic, transonic, supersonic, and hypersonic flight requirements. Thus, in order to improve the performance of the aircraft in the low-speed phase of flight, the front fuselage is designed with a modified waverider configuration.

Improve aerodynamic performance by changing the sweep angle

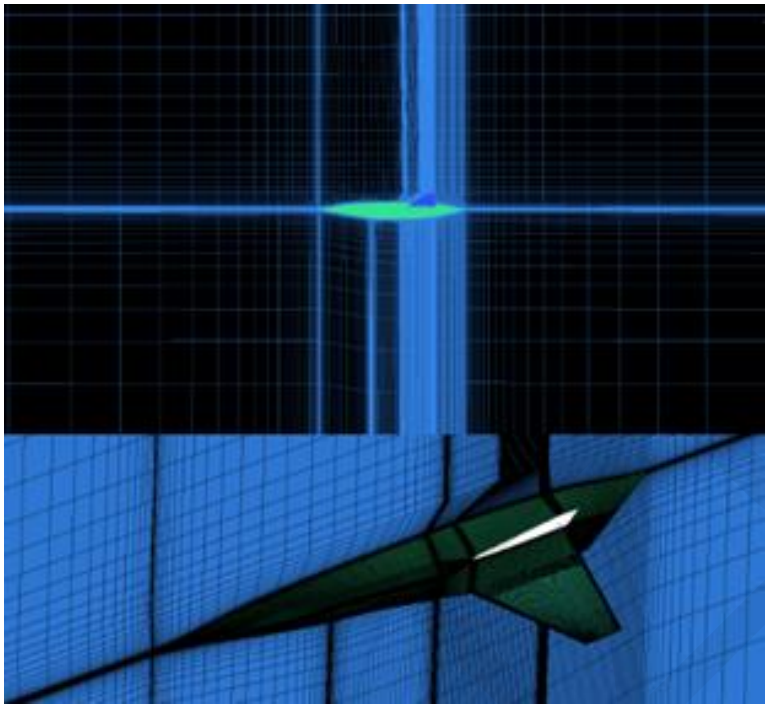
Sub-transonic



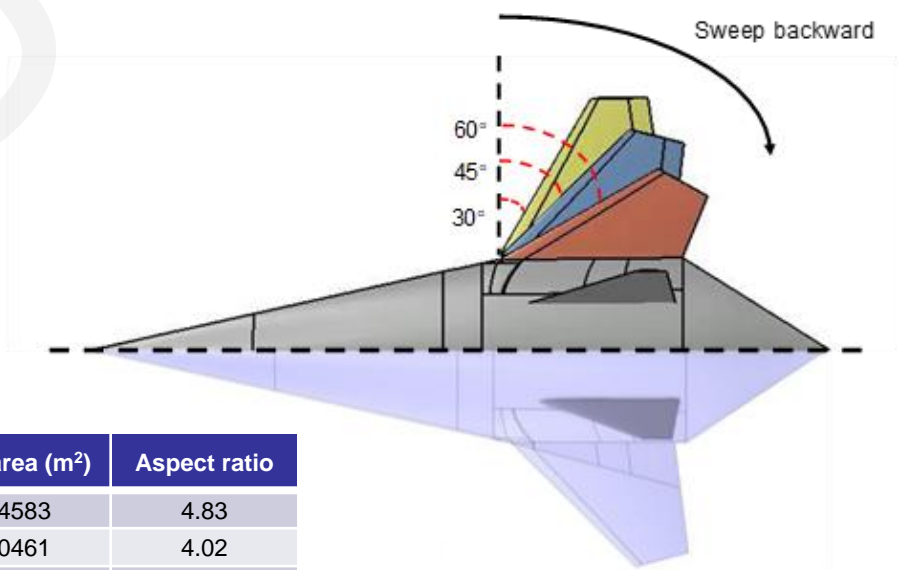
Supersonic



Hypersonic

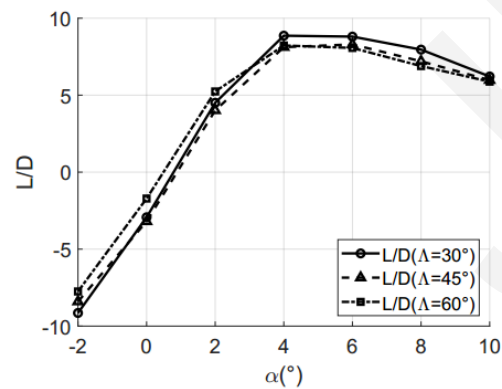
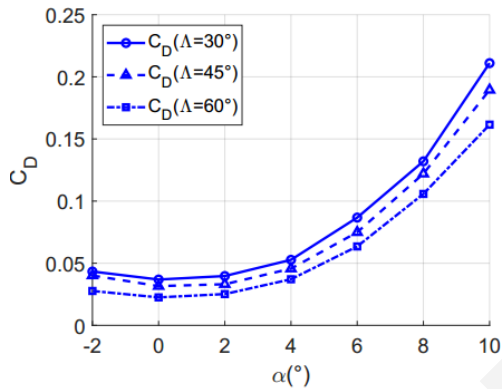
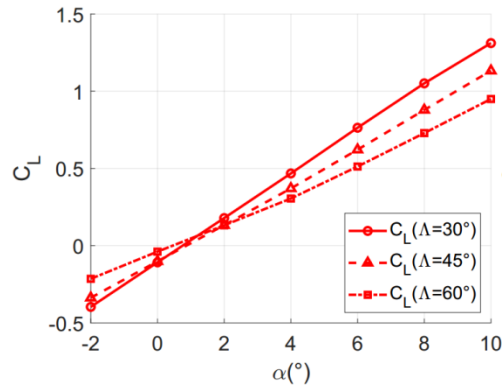


Altitude (km)	Temperature (K)	Pressure (Pa)	Mach number
0	288.150	101325.00	0.3
5	255.676	54048.30	0.9
10	223.252	26499.90	1.5
14	216.650	14170.40	3
16	216.650	10352.80	4
22	218.574	4047.50	6
25	221.552	2549.22	7

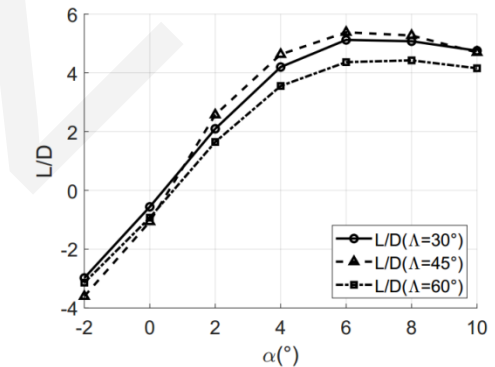
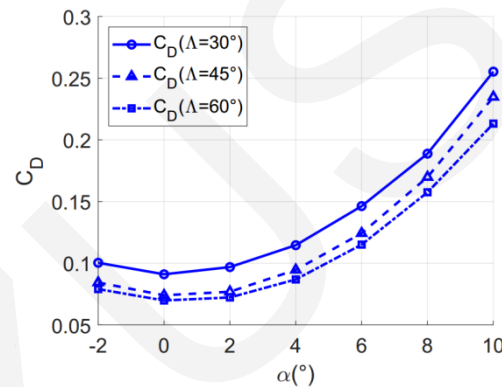
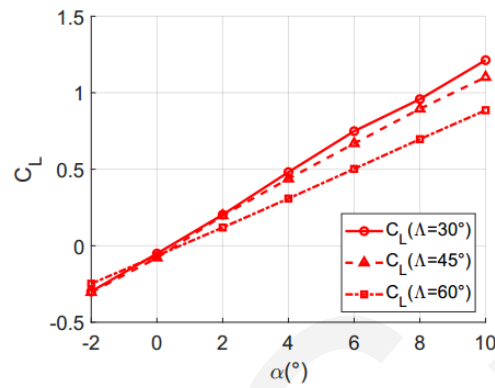


Sweep angle, Λ (°)	Root chord (m)	Tip chord (m)	Span (m)	Wing area (m ²)	Aspect ratio
30	6.6277	2.2016	20	56.4583	4.83
45	6.6176	2.2016	17.7668	45.0461	4.02
60	7.0895	2.2016	17.7279	33.008	3.82

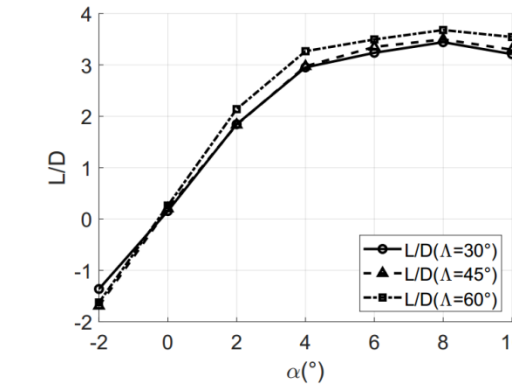
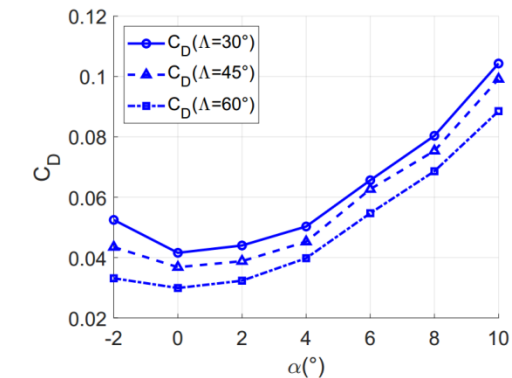
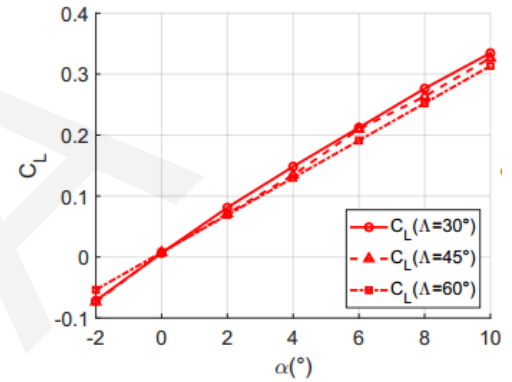
Aerodynamic Data Analysis



Mach 0.3

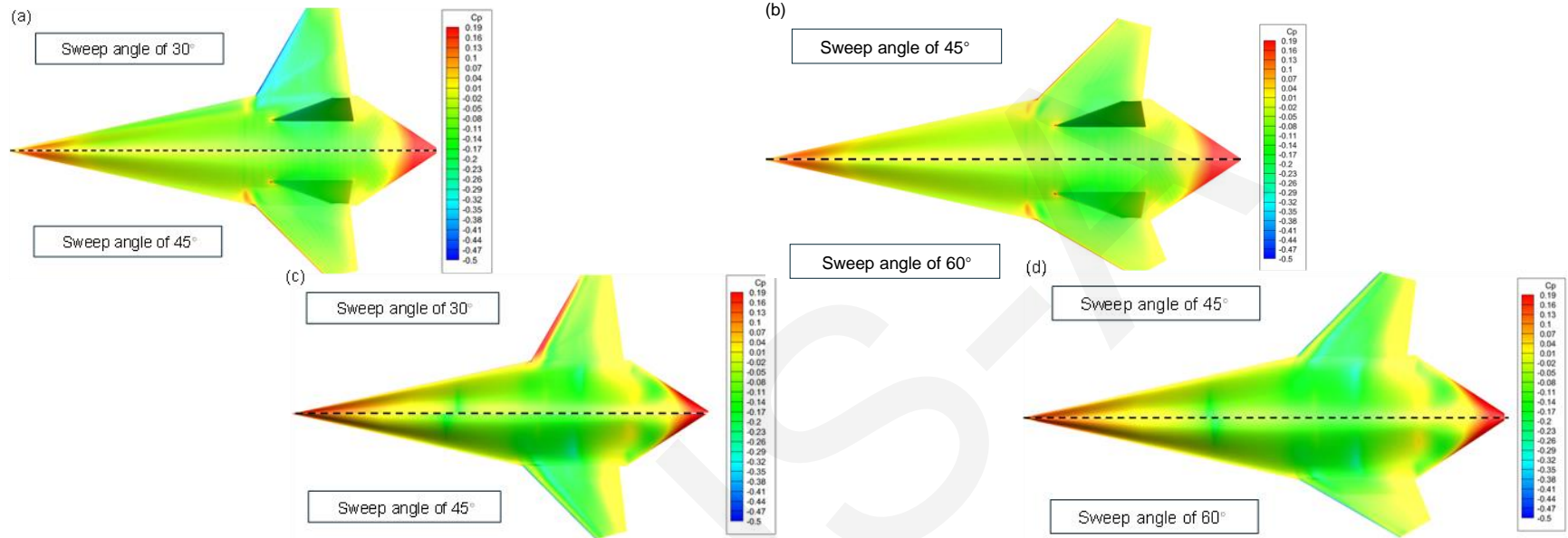


Mach 1.5

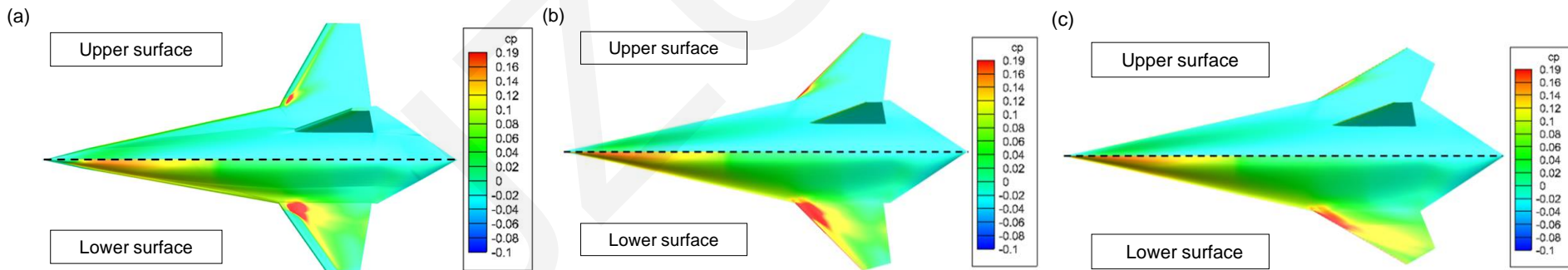


Mach 7

Preliminary discussion on configuration differences



Comparisons of pressure coefficient contours of four configurations (Mach 0.3, $\text{Alpha}=0^\circ$)



Comparisons of pressure coefficient contours of the three configurations (Mach 7, $\text{Alpha} = 6^\circ$)
(a) $\Lambda=30^\circ$; (b) $\Lambda=45^\circ$; (c) $\Lambda=60^\circ$

Conclusions

- A morphing-sweep-wing vehicle achieves superior aerodynamic efficiency compared to fixed-wing designs across a broad range of speeds.
- The lift-to-drag ratio of the vehicle at this speed reaches a maximum of approximately 8.804, which provides strong aerodynamic support for horizontal takeoff.
- In future work, the inlet of the vehicle will be designed based on the optimized aerodynamic profile, and the interactions of airflow through the inlet will be analyzed.