The DLR Project LamAiR: Design of a NLF Forward Swept Wing for Short and Medium Range Transport Application

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The LamAiR (*Lam*inar *Air*craft *R*esearch) project deals with the design of a laminar wing for short and medium range transport aircraft operated in the transonic regime. It is well known that extensive laminar flow on wings of such aircraft still can be achieved by natural means, i.e. solely by contour shaping of the airfoil sections. But with Reynolds numbers being in the order of 25 millions in cruise condition the leading edge sweep of the wing should not be higher than approximately 20deg in order to limit the growth of cross-flow instabilities and, hence, prevent early transition. Consequently, the design cruise Mach number for laminar wings of conventionally aft-swept configurations cannot exceed values of about 0.75 and it is expected that the high-speed off-design performance is rather poor. Within the DLR project LamAiR it is therefore investigated if these aerodynamic shortcomings can be overcome by employing forward sweep in combination with aeroelastic tailoring using CFRP (Carbon Fiber Reinforced Plastics) materials. In particular the goal is to design a forward swept laminar wing having a design Mach number of 0.78 and the capability of reaching Mach 0.80 in high-speed off-design. The present paper gives an overview on the current status of the project as well as prospects for future work.

Nomenclature

ALT	=	attachment line transition
C_L	=	lift coefficient
CFI	=	crossflow instability
CFRP	=	carbon fiber reinforced plastics
C_P, C_P^*	=	pressure coefficient and critical pressure coefficient
c	=	chord length
c_l	=	section or local lift coefficient
c_{df}	=	section friction drag coefficient
c_{dw}	=	section wave drag coefficient
c_{m25}	=	pitching moment about quarter chord point
dc	=	drag counts
NLF	=	natural laminar flow
N_{CF}	=	crossflow N-factor
N_{CF}	=	crossflow N-factor
M	=	Mach number
Re_{AMC}	=	Reynolds number based on aerodynamic mean chord

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