Erratum to "Roll Stall for Low-Aspect-Ratio Wings" (Journal of Aircraft, Vol. 50, No. 4, pp. 1060-1069)

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With improved measurement capabilities of the newly accrued measurement facility,[1] the authors wish to update figure 6 in the recent article[2] with more accurate results shown in figure 1 here. The more accurate data shows larger roll moments than reported in Shields and Mohseni,[2] which amplifies the importance of the reported roll-stall phenomenon.

Figure 1 shows that the smaller aspect-ratio wing in side-slip generates significantly larger roll moments, with respect to its wing area, than that of the larger aspect-ratio wing. This is strictly due to the attitude of the tip vortices in cross-flow. Both the induced asymmetric downwash and suction-side pressure generated by the tip vortex on the wing, results in large roll moments without the presence of vertical wing modifications.

The tapered wing roll moment data, figure 8 in Shields and Mohseni,[2] are now replaced by figure 2.

Near-zero sideslip roll moment measurements still show a small non-zero gradient with respect to angle of attack even in the improved measurement facility. Figure 3 shows coefficient of roll moment measurements, with associated measurement errors, at near-zero sideslip for the AR 1 wing. Though all roll moments measured at zero sideslip are very small, the small gradient is likely attributed to asymmetries in the flow field over the wing due to leading-edge/side-edge imperfections.

Presented lateral stability derivative values, (C_{l_β}), in Table 2 of the article[2] are also updated. Replacement C_{l_β} values, computed from small sideslip angles $\beta = 0 - 10^\circ$ of both rectangular and tapered wings, are shown in Table 1. From a stability perspective, the large C_{l_β} derivative of low-aspect-ratio planar wings indicates that large restorative moments are generated in the presence of relatively small equilibrium perturbations. The gusty environments for which low-aspect-ratio flyers reside will act to continually exploit this stability hazard if it is not properly addressed.

The in-text analysis on the replaced data remains unchanged from what is published, as discussions were mostly made regarding trends across the tested models and not regarding individual magnitudes. The impact of all reported phenomena, most notedly of the occurrence 'roll stall' and the uncharacteristically large C_{l_β} for low-aspect-ratio planar wings, are magnified with the replaced data.

References

[1] Linehan, T., Shields, M., and Mohseni, K., "Development, characterization, and validation of a four axis wind tunnel positioning system," *Proceedings of the AIAA Aerospace Sciences Meeting*, No. 2014-1308, National Harbor, MD, USA, January 13-17 2014.

[2] Shields, M. and Mohseni, K., "Roll stall for low-aspect-ratio wings," *Journal of Aircraft*, Vol. 50, No. 4, 2013, pp. 1060–1069.

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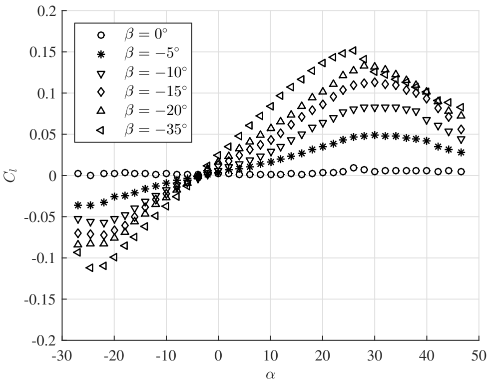
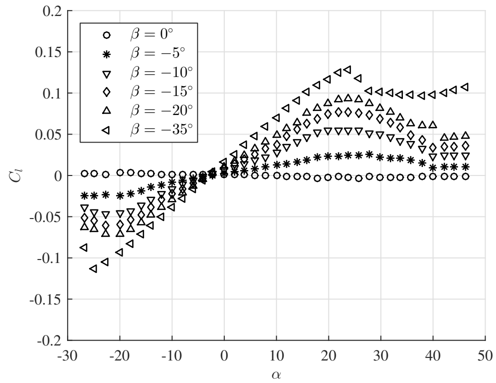
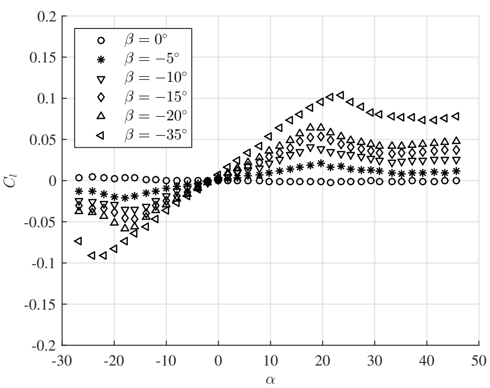


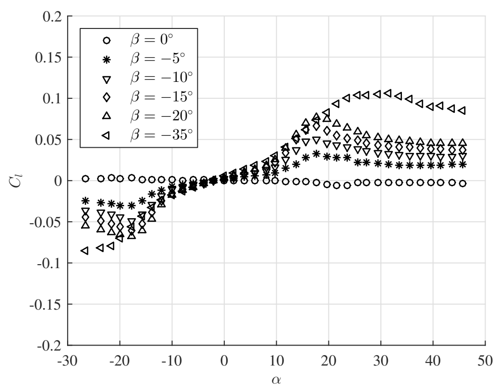
(a) $AR = 0.75$



(b) $AR = 1$



(c) $AR = 1.5$

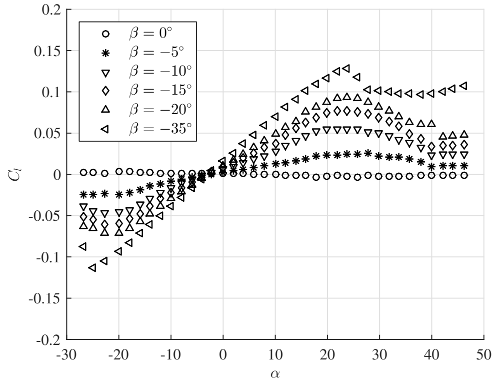


(d) $AR = 3$

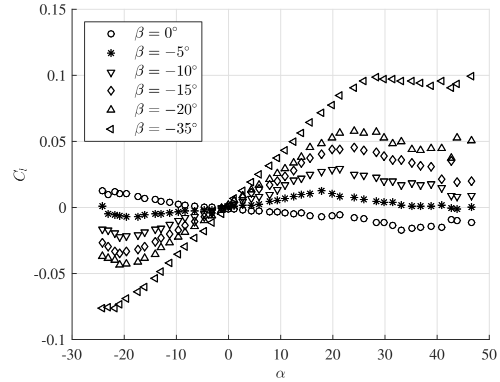
Figure 1: Roll moment coefficient for rectangular flat-plate wings in sideslip at $Re = 7.5 \times 10^4$. Angle of attack, α, in units of deg.

Table 1: Values of $C_{l,\beta}$ for various planform geometries and trim angles

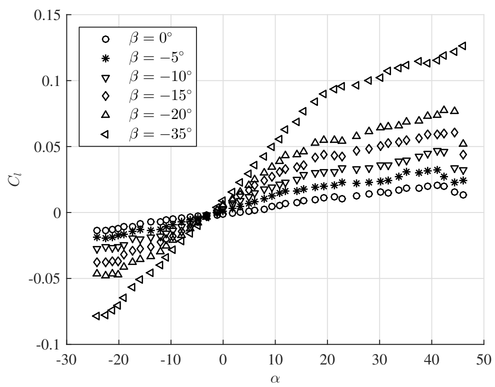
AR	λ	$\alpha = 5$ deg	$\alpha = 10$ deg	$\alpha = 15$ deg	$\alpha = 20$ deg
0.75	1	-0.087	-0.159	-0.257	-0.348
1	1	-0.091	-0.164	-0.260	-0.325
1.5	1	-0.067	-0.127	-0.200	-0.225
3	1	-0.046	-0.103	-0.260	-0.282
1	0.75	-0.058	-0.109	-0.170	-0.197
1	0.5	-0.065	-0.088	-0.107	-0.113
1	0.25	-0.035	-0.052	-0.058	-0.040



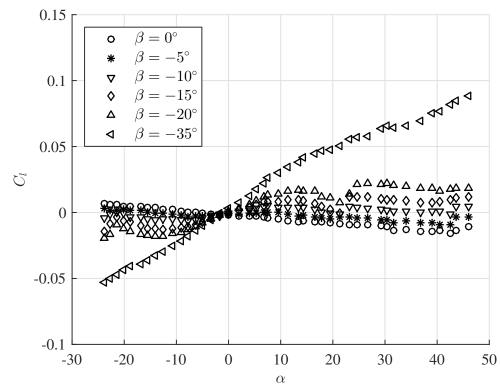
(a) $\lambda = 1$



(b) $\lambda = 0.75$



(c) $\lambda = 0.5$



(d) $\lambda = 0.25$

Figure 2: Roll moment coefficient for tapered flat-plate wings with $AR = 1$ in sideslip at $Re = 7.5 \times 10^4$. Angle of attack, α, in units of deg.

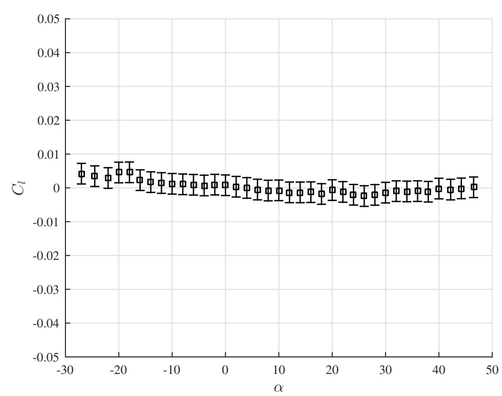


Figure 3: Roll moment coefficient (C_l) for an $AR = 1$ flat-plate wing at near-zero sideslip angles at $Re = 7.5 \times 10^4$. Angle of attack, α, in units of deg. Error bars are associated with both bias and random errors of the measurement equipment. Bias errors were retrieved from force/moment calibration of the MLT balance. Random error is calculated from the statistics of the roll moment with the wing in the tunnel at $\alpha = 0°, \beta = 0°$.