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Effect of Roll Angle Configurations of a Reverse Delta Type Add-on Device on Wing Tip Vortex Alleviation
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Abstract

An add-on device in the shape of a reverse delta has shown the ability to alleviate wake vortices. The present work studies the interaction of the wing tip vortex and the reverse delta type add-on device vortices. This paper looks at the vortex interactions generated downstream of the wing tip in planes perpendicular to the free stream direction and their dependence on roll angles ϕ at a mean chord-based Reynolds number of $Rec=2.75 \times 10^5$. The study reveals that the add-on device causes a reduction in the tangential velocity $V\theta$ and vorticity of the resultant vortex by up to 44.1% and 59.4%, respectively. Also, it is found that the resultant vortex core radius increased by 305%. The results indicate that the reverse delta type add-on device implants countersign vorticity into the wing tip vortex and modifies its roll-up process. © 2024, Semarak Ilmu Publishing. All rights reserved.

Author Keywords

Add-on device; PIV; Vortex; Wing tip

References

- Babie, B.M., Nelson, R.C.
Flow visualization study of far-field wake vortex interactions
(2004) *Proceedings of 11th International Symposium on Flow Visualization*, Paper No. 11ISFV-103, August
- Veillette Patrick, R.
Data show that U.S. Wake-Turbulence Accidents are most Frequent at Low Altitude and During Approach and Landing
(2002) *Flight Safety Foundation, Flight Safety Digest*, pp. 1-56.
March April
- Vernon, Rossow
Effect of Wing Fins on Lift-Generated Wakes
(1978) *Journal of Aircraft*, 15 (3), pp. 160-167.
J
- Schell, I., Özger, E., Jacob, D.
Influence of different flap settings on the wake-vortex structure of a rectangular wing with flaps and means of alleviation with wing fins
(2000) *Aerospace Science and Technology*, 4 (2), pp. 79-90.
- Ozger, E., Schell, I., Jacob, D.
On the Structure and Attenuation of an Aircraft Wake
(2001) *Journal of Aircraft*, 38 (5), pp. 878-887.
- Heyes, A. L., Smith, D. A. R.
Spatial perturbations of a wing-tip vortex using pulsed span-wise jets
(2004) *Experiments in Fluids*, 37 (1), pp. 120-127.

- Schöll, Robert, Buxel, Christian, Neuwerth, Günther
Influence of spanwise loading and fins on extended near-field vortex wake
(2006) *44th AIAA Aerospace Sciences Meeting and Exhibit, Aerospace Sciences Meetings*,
- Ortega, J. M., Bristol, R. L., Savas, O.
Wake alleviation properties of triangular-flapped wings
(2002) *AIAA Journal*, 40 (4), pp. 709-721.
- Ortega, J. M., Bristol, R. L., Savaş, Ö.
Experimental study of the instability of unequal-strength counter-rotating vortex pairs
(2003) *Journal of Fluid Mechanics*, 474, pp. 35-84.
- Breitsamter, C.
Wake vortex characteristics of transport aircraft
(2011) *Progress in Aerospace Sciences*, 47 (10), pp. 89-134.
- Bellastrada, C., Breitsamter, C.
Effect of differential flap settings on the wake vortex evolution of large transport aircraft
(2006) *Notes on Numerical Fluid Mechanics and Multidisciplinary Design*, 92, pp. 25-32.
- Coustols, Eric, Stumpf, Eike, Jacquin, Laurent, Moens, Frédéric, Vollmers, Heinrich, Gerz, Thomas
Minimised wake: A collaborative research programme on aircraft wake vortices
(2003) *41st AIAA Aerospace Sciences Meeting and Exhibit*, pp. 1-15.
- Elsayed, Omer A., Asrar, Waqar, Omar, Ashraf A., Kwon, Kijung
Influence of differential spoiler settings on the wake vortex characterization and alleviation
(2010) *Journal of Aircraft*, 47 (5), pp. 1728-1738.
- Elsayed, Omer A., Omar, Ashraf A., Asrar, Waqar, Kwon, Kijung
Effect of differential spoiler settings (DSS) on the wake vortices of a wing at high-lift-configuration (HLC)
(2011) *Journal of Aerospace Science and Technology*, 15 (7), pp. 555-566.
- Lee, T., Su, Y. Y.
Wingtip vortex control via the use of a reverse half-delta wing
(2012) *Experiments in Fluids*, 52 (6), pp. 1593-1609.
- Altaf, Afaq, Thong, Tan Boon, Omar, Ashraf A., Asrar, Waqar
Influence of a Reverse Delta Type Add-on Device on Wake Vortex Alleviation
(2016) *AIAA Journal*, 54 (2), pp. 625-636.
- Altaf, Afaq, Thong, Tan Boon, Omar, Ashraf Ali, Asrar, Waqar
Impact of a Reverse Delta Type Add-on Device on the Flap-tip Vortex of a Wing
(2016) *International Journal of Aviation, Aeronautics, and Aerospace*, 3 (3), pp. 1-26.
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- Altaf, Afaq
Wingtip Vortex Alleviation Using a Reverse Delta Type Add-on Device
(2017) *International Journal of Aviation, Aeronautics, and Aerospace*, 4 (3), pp. 1-28.
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