NOMENCLATURE

Eabsorbed	The energy that can be absorbed by the shock	kg
WL	Weight of the aircraft at landing (MTOW)	kg
Ng	The landing gear load factor Ng = 3 (for Aircraft type: General aviation)	
ht	Tyre efficiency ht = 0.47 [4]	
St	The tire deflection St = 0.25 inch (for bias-ply, Static load 1800 Lbs [5])	inch
hs	Shock absorber efficiency Hs = 0.8 (for Shock Absorber type: Oleo-pneumatic [4])	
Ss	The shock absorber stroke	m
Vz	Design touchdown rates Vz = 8.2 fps (FAR 23: 7 – 10 fps)	fps
g	Acceleration due to gravity g = 9.81 m/s^2	m/s^2
ns	number of main gear struts	
Pm	The maximum static load per main gear	kg

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REFERENCES

[1] N. Raičević, A. Grbović, G. Kastratović, N. Vidanović, and A. Sedmak, "Fatigue life prediction of topologically optimized torque link adjusted for additive manufacturing," *Int J Fatigue*, vol. 176, p. 107907, 2023, doi: https://doi.org/10.1016/j.ijfatigue.2023.107907.

[2] P. Thota, B. Krauskopf, and M. Lowenberg, "Interaction of torsion and lateral bending in aircraft nose landing gear shimmy," *Nonlinear Dyn*, vol. 57, pp. 455–467, 2009.

[3] C. Douglas, A. Ellis, R. K. Schmidt, and I. Kim, "Multidisciplinary Design Optimization of Aircraft Landing Gear," in *AIAA Aviation 2021 Forum*, 2021, p. 3023.

[4] M. Rahmani and K. Behdinan, "Interaction of torque link freeplay and Coulomb friction nonlinearities in nose landing gear shimmy scenarios," *Int J Non Linear Mech*, vol. 119, p. 103338, 2020, doi:10.1016/j.ijnonlinmec.2019.103338.

[5] M. Rahmani and K. Behdinan, "Structural design and optimization of a novel shimmy damper for nose landing gears," *Structural and Multidisciplinary Optimization*, vol. 62, no. 5, pp. 2783–2803, 2020, doi: 10.1007/s00158-020-02628-x.

[6] S. Singh, R. Chaudhary, V. K. Pathak, and V. Saxena, "Design Optimization of Torque Link of an Aircraft Landing Gear Assembly," in *Advances in Materials and Mechanical Engineering*, C. Pandey, V. Goyat, and S. Goel, Eds., Singapore: Springer Singapore, 2021, pp. 145–153.

[7] Y. Jiang, G. Feng, P. Liu, L. Yuan, J. Ding, and B. Jiang, "Influence of Nose Landing Gear Torsional Damping on the Stability of Aircraft Taxiing Direction," *Aerospace*, vol. 9, no. 11, Nov. 2022, doi:10.3390/aerospace9110729.

[8] A. Krishnan, V. Thejus, and B. M. Arjun, "Numerical investigation of structural design of torsion links in a landing gear retraction mechanism," in *2017 2nd International Conference for Convergence in Technology (I2CT)*, IEEE, 2017, pp. 382–388.

[9] M. Mahardika, R. A. Wicaksono, M. G. Widiastuti, and B. Arifvianto, "Finite Element Analysis of Osteosynthesis Miniplate for the Reconstruction of Parasymphyseal Compound Fracture," vol. 8, no. 3, 2018.

[10] M. Minhat, S. B. Mohamed, M. S. Kasim, M. A. Sulaiman, and Z. I. Rizman, "Advanced manufacturing of an aircraft component (fish-head): A technology review on the fabrication," *Int J Adv Sci Eng Inf Technol*, vol. 6, no. 5, pp. 734–739, 2016.

[11] Y. Yin, K. Xu, H. Nie, X. Wei, and H. Wang, "Dynamics analysis of spatial landing-gear mechanism with hinge clearance and Axis deviation," *J Aircr*, vol. 58, no. 1, pp. 30–42, 2021.

[12] L. Cheng, H. Cao, and L. Zhang, "Two-parameter bifurcation analysis of an aircraft nose landing gear model," *Nonlinear Dyn*, vol. 103, no. 1, pp. 367–381, 2021, doi: 10.1007/s11071-020-06129-w.

[13] L. Lin, C. Tong, F. Guo, S. Fu, Y. Lv, and W. He, "A Self-Attention Integrated Learning Model for Landing Gear Performance Prediction," *Sensors*, vol. 23, no. 13, p. 6219, 2023.

[14] L. Son, K. E. Adipta, and M. Bur, "Analysis of the static behavior of a new landing gear model based on a four-bar linkage mechanism," *Int. J. Technol*, vol. 10, 2019.

[15] Y. Jiang, G. Feng, P. Liu, L. Yuan, J. Ding, and B. Jiang, "Evaluation of Joint Clearance Effects on the Shimmy of Nose Landing Gear," *Aerospace*, vol. 10, no. 8, p. 722, 2023.

[16] J. A. Griffin and T. T. Takahashi, "A Break from Tradition: The 'New' 14 CFR Part 23 and Consensus Standards," in *AIAA Scitech 2023 Forum*, 2023, p. 0116.

[17] L. Miller and R. Jansen, "Structural Requirements for Design and Analysis of 25% Scale Subsonic Single Aft Engine (SUSAN) Research Aircraft," in *AIAA Scitech 2023 Forum*, 2023, p. 1939.

[18] Z. Wu, "Modeling and simulation of aircraft nose landing gear extension retraction system," in *Proc.SPIE*, Sep. 2022, p. 122615A. doi: 10.1117/12.2638894.

[19] W. R. Krüger and M. Morandini, "Recent developments at the numerical simulation of landing gear dynamics," *CEAS Aeronaut J*, vol. 1, pp. 55–68, 2011.

[20] H. Borouchaki and P.-L. George, "Quality mesh generation," *Comptes Rendus de l'Académie des Sciences-Series IIB-Mechanics*, vol. 328, no. 6, pp. 505–518, 2000.

[21] G. Balarac *et al.*, "Tetrahedral remeshing in the context of large-scale numerical simulation and high performance computing," *MathematicS In Action*, vol. 11, no. 1, pp. 129–164, 2022, doi: 10.5802/msia.22.

[22] M. A. Ahmad, N. N. M. E. Zulkifli, S. Shuib, S. H. Sulaiman, and A. H. Abdullah, "Finite Element Analysis of Proximal Cement Fixation in Total Hip Arthroplasty," *International Journal of Technology*, vol. 11, no. 5, pp. 1046–1055, Nov. 2020, doi: 10.14716/ijtech.v11i5.4318.

[23] S. Echaroj, N. Pannucharoenwong, and P. Rattanadecho, "Development of Vehicle Chassis from Novel Materials for Light Weight Electric Shuttles Using Finite Element Analysis," *Science & Technology Asia*, vol. 26, no. 3, doi: 10.14456/scitechasia.2021.47.

[24] M. N. Zulkifli, I. Ilias, A. Abas, and W. M. W. Muhamad, "Finite element analysis of thermoelectric generator with aluminum plate for waste heat recovery application," *Int J Adv Sci Eng Inf Technol*, vol. 7, no. 4, pp. 1328–1333, 2017.

[25] M. Akbar *et al.*, "Evaluation on Piezoaeroelastic Energy Harvesting Potential of A Jet Transport Aircraft Wing with Multiphase Composite by means of Iterative Finite Element Method," *Evaluation*, vol. 13, no. 4, 2022.

[26] F. Nikodem, F. Möller, P. Gallun, and A. Bierig, "Design of a retractable landing gear for the sagitta demonstrator UAV," 2017.

[27] E. Satria, S. Haris, and R. Saputri, "Static and Dynamic Analysis of Steel U-Damper for Space Structures," vol. 8, no. 1, 2018.