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DROP TEST SIMULATION FOR AN AIRCRAFT LANDING GEAR VIA MULTI-BODY APPROACH

This work deals with the effectiveness of a multi-body approach for the study of the dynamic behavior of a fixed landing gear, especially the research project concerns the drop tests of the AP.68 TP-300 aircraft. First, the Digital Mock-up of the of landing gear system in a C.A.D. software has been created, then the experimental structural stiffness of the leaf spring has been validated using the FEM tools MSC.Patran/Nastran. Finally, the entire model has been imported in MSC.ADAMS environment and, according to the certifying regulations, several multi-body simulations have been performed varying the heights of fall and the weights of the system. The results have shown a good correlation between numerical and experimental tests, thus demonstrating the potential of a multi-body approach. Future development of the present activity will probably be an application of the methodology, herein validated, to other cases for a more extensive validation of its predictive power and development of virtual certification procedures.

1. Introduction

The landing gear of an aircraft is a multi-degree of freedom mechanical device used for take-off, landing and rolling maneuvers. This paper is aimed to characterize the dynamic behavior of a landing gear undergone to drop-test, using a multi-body approach. An advanced engineering tool was used to design and simulate the drop test, finalized to reproduce the landing phase of an aircraft to certification purposes.

The present paper is included in an activity having the ultimate goal of creating a simulation methodology, validated in extended and robust manner, able to help the aircraft manufacturers for developing new landing gear designs and helping them during the certifying procedures, using a virtual

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drop test based approach. Once defined the aircraft category, the certification of the landing gear is regulated by the *14 Code of Federal Regulation (CFR) Part 23* that define two types of drop test called *Limit Drop Test* [1] and *Reserve Energy Absorption Drop Test* [2]. Both drop tests require the use of a specific test facility.

In recent years both civil and military organizations have put great effort into optimization of the landing gear and its components since, in future, simulations will play an ever increasingly role especially in the introduction of new ideas and systems [3] for engineering applications. A first overview of computer simulation of aircraft and landing gear was given by Doyle [4] in the 80s. Shepherd, Catt, and Cowling [5] described a program funded by British Aerospace for the analysis of aircraft-landing gear interaction with a high level of detail, including brakes and anti-skid, steering control, to simulate standard hardware rig-test (dynamometer and drop tests) as well as flight tests, involving ground contact. Barnes and Yager [6] discussed the use of simulators for aircraft research and development.

Hitch [7] and Krüger et al [8] in their works published by IAVSD (International Association for Vehicle System Dynamics) and Pritchard [9] in his work produced at NASA Langley Research Center gave an overviews on the aircraft landing gear dynamics highlighting the importance of the tires and their interaction with the ground. In 1941s, von Schlippe and Dietrich [10], analyzed the shimmy phenomenon describing analytically the interaction of the landing gear leg stiffness with the forces acting on tires. Pacjeka [11] used a similar tire model based on the stretched string concept and developed simple derivatives representing first order lag with a relaxation length and a gyroscopic couple coefficient as parameters. Bakker and Pacjeka [10, 12] using trigonometric functions, developed an empirical formula for the description of steady state slip, known in literature as “Magic Formula”. Recently this formulation was extended to include dynamic tire behavior [13].

Concerning the dynamic simulation of the landing gear, an interesting state of the art was presented by Rook et al [14] in their report developed at the BF Goodrich Aerospace.

The aircraft involved in the present study is the AP.68 TP-300, a nine-seat, twin-engined, high-wing monoplane, projected by Luigi Pascale, Professor at Aerospace Engineering Department of the University of Naples ’Federico II’ and built by Partenavia, later Vulcanair S.p.a.. This version of AP.68 uses a fixed landing gear. The employment of this typology of landing gear presents some advantages because it is particularly suitable for semi prepared strips and hard working conditions, and it is an important factor in maintenance costs reduction.

In this work an ADAMS multi-body software tool has been used to create a procedure for reproducing in a simulative manner the drop tests, prescribed by normative. After the realization of Digital Mock-up of the main components of landing gear in a C.A.D. software, they have been imported in ADAMS environment and the entire model has been assembled connecting the parts through appropriate joints. The system of fall used for the drop test and the fuselage have been modeled in ADAMS environment as rigid bodies, while leaf spring and tires have been simulated as flexible bodies. For this purpose the C.A.D. model of leaf spring has been imported in Patran Software to create with a Nastran solution a Modal Neutral File. Furthermore, the F.E.M. model of the leaf spring has been validated in terms of structural stiffness through a comparison between some static linear/non linear simulations and data of the static experimental tests performed at that time.

The tire has been modeled using the module ADAMS Tire, including the information about geometry, inertia and vertical stiffness (experimentally defined) by the Goodyear Company. Information about the ground has been added in a Road Data file. In correspondence of the wheels of aircraft at the level of the ground the presence of a chock with angle 16° or 18.5° has been simulated because they are presented in the experimental drop test. Finally, the entire test article was modeled and connected to the fuselage.

The multi-body model created in ADAMS has been validated thanks to the match between experimental data [15] and results of dynamic simulation of multi-body software. For each drop test the match has been made on time histories of two parameters, measured experimentally by accelerometer and displacement transducer, installed on the test article. Time histories for the experimental/numerical correlation are about the "load factor developed in the drop test" n_j (as defined in the paragraph "e" of [1]) and the "deflection of the landing gear (indicated as "d" in paragraph "b" of [1]) after the first impact with the ground during the drop test. The comparison between numerical and experimental results in terms of load factors for various heights and equivalent mass, in accordance with CS-23 (Certification Specifications for Normal, Utility, Aerobatic and Commuter Airplanes), has shown a good correlation.

2. Landing gear and experimental set-up description

This work is aimed to reproduce drop tests of the AP.68 TP Spartacus carried out by Partenavia SpA, according to the normative (FAR Part 23.723-727).

The system of fall used for the tests is reported in Figure 2, while an exploded view drawing of the landing gear is shown in Figure 1. The landing gear is composed by a leaf spring connected to the fuselage in two positions. At the root of the leaf spring, the connection is a double hinge; while, at 50 cm from the root, the leaf spring is bound to the fuselage through a frame that allows a deflection of the leaf spring. Finally, the tire is mounted on a linchpin clamped to the edge of the leaf spring.

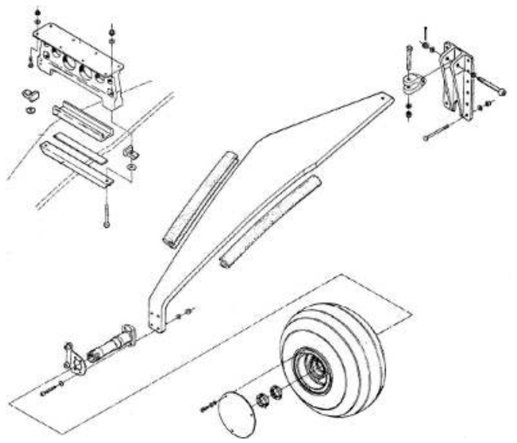


Fig. 1. Exploded view drawing of the landing gear

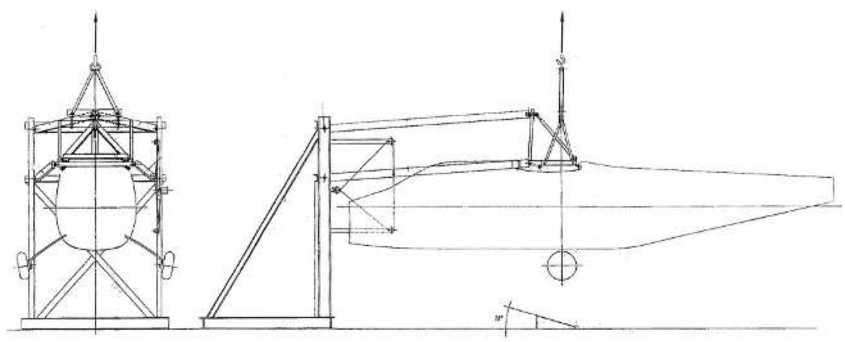


Fig. 2. Outline of the system of fall connected to the pantograph

To meet the absence of wings, nose and tail control surfaces, some balancing masses had been disposed on the fuselage. Then, the system is connected to a pantograph that guarantees a fall with constant trim, in order to reproduce the operative landing conditions.

The pantograph is a metal structure composed by four arms with rectangular section hinged to structure that is fixed to the ground. Then, the four arms are hinged to a metallic cage that is fixed to the system of fall. The pantograph assures an almost perfect vertical fall to the complex.

A scheme of the complex, connected to the pantograph, is shown in Figure 2.

The balancing masses are disposed in order to align the center of mass of the complex on the intersection of the two landing gear's symmetry planes. In this way, it is possible to reduce the presence of undesired roll and/or pitch moments that could contaminate the data acquisition during tests.

To reproduce critical landing conditions (critical descend trim), the tires impact on two wedges with an inclination of 16° and 18° (depending from the maximum landing weight). To simulate particular grip conditions, wedges are lubricated with grease. Regarding the height from which the complex falls, it also depends from the maximum landing weight (this dependence is specified by the normative) and it refers to the distance between the lower edge of the tire and the ground (or the wedge if present). Finally, the instrumentation used to acquire data during the tests is composed of:

1. three accelerometers on the fuselage in order to measure the vertical acceleration of the complex. The position of three accelerometers has been established so that, averaging the three output signals, the noise caused by eventual moment of pitch and roll can be easily removed.
2. A displacements sensitive potentiometer to measure the height of fall. The potentiometer measures the distance between the linchpin and the ground. In the initial position, this distance is given by the sum of the height of fall plus the radius of the tire.

3. Numerical/experimental analysis of the leaf spring

Starting from the technical drawings of spring leaf and linchpin, using a 3D CAD Software, the digital mock-up of the system has been created (Figure 3).

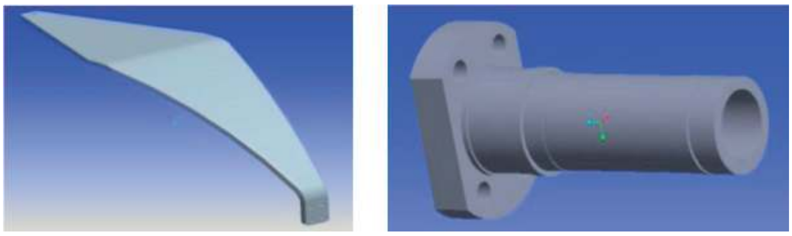
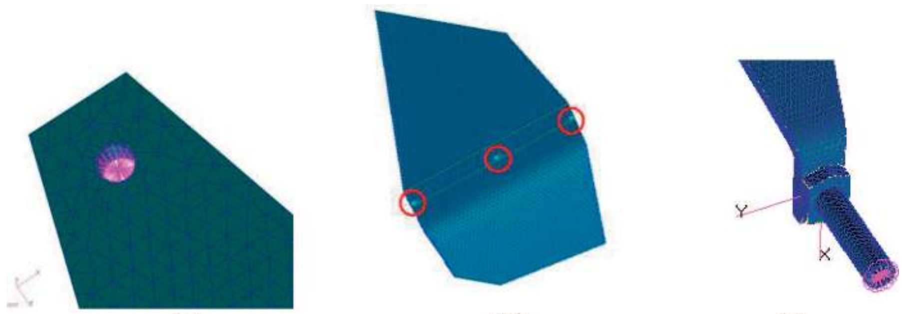


Fig. 3. Digital Mock-up spring leaf and shaft

Afterwards, the CAD model has been imported in a FEM pre/post processor: MSC Patran. Below the main information of the FEM model is reported:

1. The entire model is meshed using 148806 elements of 3D tetra4 type. Mesh in not uniform in the model but there is a major concentration of elements near to the holes.
2. A 3D hinge (ball and socket joint) (Figure 4a) is used to model the double hinge at the root of the spring leaf, depicted in Figure 1. Rigid body elements (RBE2) elements (visible in Figure 4a as violet lines) connect the node, in which the hinge is defined, with all nodes of the inner cylindrical surface of the hole, located at the root of the spring leaf. The RBE2 is an element that creates an infinitely rigid constraint between the two nodes of extremity that are connected by the element. In this manner is created a Multi Point Constraint (MPC).
   In order to take into account the presence of the frame system that connects the leaf spring to the fuselage, three nodes (red circles in Figure 4b), located along the main axis of the rectangular surface in the central zone of the leaf spring, have translational degrees of freedom locked in the in x, y and z directions of the coordinates' reference system (visible in Figure 5). Obviously, in each of the three points, concentrated forces (constraint forces) works in the direction of the suppressed degrees of freedom.
3. In a first model, at the interface between the leaf spring and the linchpin an infinitely rigid fixed constraint was defined. In this way, the linchpin arranges one body with the leaf spring.
   The central node of the outer extreme circulars section of the linchpin (the node on which the tire will be mounted on), is connected to the nodes of the inner surface of the extreme circular section of the linchpin through a MPC (Figure 4c). In a preliminary analysis, the linchpin showed an almost rigid behavior, hence for this reason we have substituted it with a MPC that connects the leaf spring and the node on which the tire will be mounted on.



(a) (b) (c)

Fig. 4. Details of FEM model

4. The material of the leaf spring is the 51CrV4 steel [17], characterized by a Young's modulus of 210GPa, a Shear modulus of 83GPa and a density of 7800Kg/m^3.
   In order to validate the structural stiffness of the leaf spring model, non-linear static simulations using Nastran solver (SOL106 with large displacements option) were performed. By way of example, the output of a simulation is shown in the figure below.

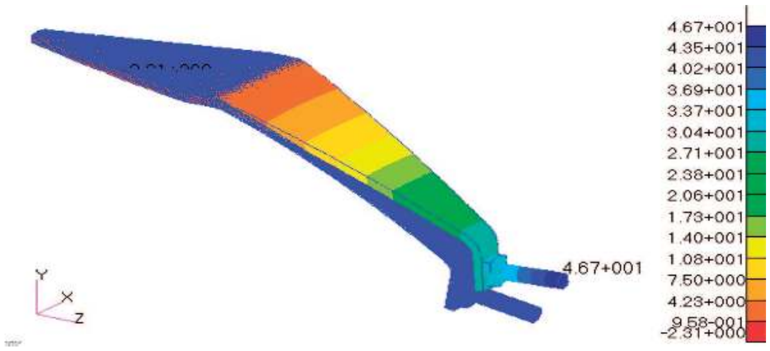


Fig. 5. Deflection of spring leaf under a load of 6810 N

Finally, in the Table 1 the results of the static simulations for different loads, compared to the experimental results [17] are presented. In Figure 6 the comparison between the numerical and experimental stiffness is proposed.

Table 1.

Numerical/Experimental comparison of spring leaf's static analysis

load [N]	Numerical deflection [mm]	Experimental deflection [mm]	Difference [%]	Numerical stiffness [Kg/mm]	Experimental stiffness [Kg/mm]	Difference [%]
2270	15	13,8	8,7	15,4	16,8	-8,0
6810	46,7	43,8	6,6	14,9	15,8	-6,2
11350	79,7	75,0	6,3	14,5	15,4	-5,9
15890	113,1	113,7	-0,5	14,3	14,2	0,5
20430	145,2	150,1	-3,3	14,3	13,9	3,4
25030	176,4	192,5	-8,4	14,5	13,3	9,1
29510	204,2	235,2	-13,2	14,7	12,8	15,2
34050	231,3	280,1	-17,4	15,0	12,4	21,1

The numerical results obtained via FEM about the static deflections of leaf spring, until medium-high loads, perfectly match compared with the experimental one. Increasing the load over 27kN the FEM simulations become

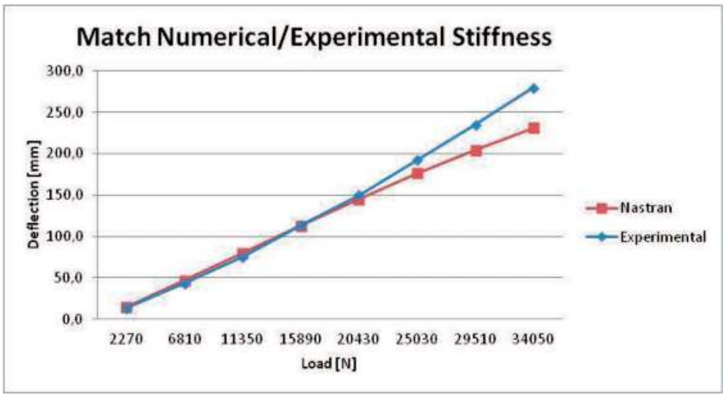


Fig. 6. Matching numerical/experimental stiffness of the leaf spring

less conservative, resulting in the higher rigidity of the entire landing gear. Then, the numerical leaf spring highlights higher stiffness compared with the real one. The different behavior of the structure at high load conditions could be due to change in the boundary conditions used in the experimental campaign and not reported in the literature report [15].

4. ADAMS model

According to dimensions and mass distribution of the system, the ADAMS model was created.

In order to guarantee the real mass distribution of the system, all the mass of the model were concentrated in a mass point aligned to the intersection of the landing gear symmetry planes. In this way the moments of inertia can be neglected, since in the experimental phase the aircraft's center of gravity lay in the intersection of the landing gear symmetry planes too. Moreover, in order to reproduce faithfully the dynamic tests of fall the pantograph was modeled.

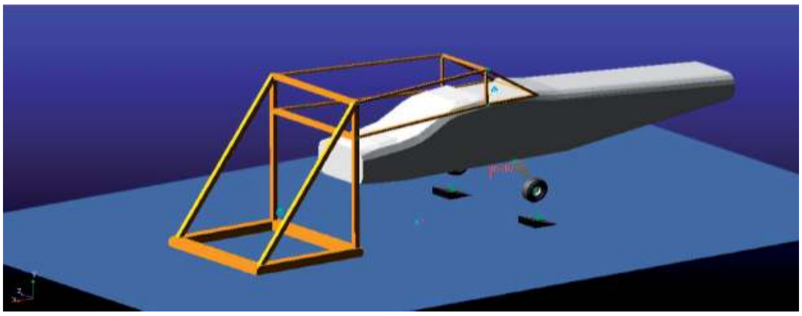


Fig. 7. Full model in ADAMS

All the steps useful to the multi-body modeling and then for the drop tests simulation are described in detail below.

4.1. Leaf spring model in MSC.ADAMS

After the FEM modeling of the leaf spring in MSC.Patran, an adequate procedure to export the model in a certain format accepted by MSC.ADAMS (Modal Neutral File), has been followed. To reduce the simulations computational time, the FEM model imported in ADAMS had been built with 2D CQUAD elements instead of 3D tetra4 elements. This choice had been supported by the good agreement among the results of the static analyses conducted on both models, indeed the match returned a small error for the most part of analyzed cases; it is also supported by a good correlation between the results of the drop tests simulations and experimental results. The generation of the mnf file is a quite complex procedure that requests the application of the super-elements method and a modal analysis of the spring leaf. Indeed the spring leaf is imported in ADAMS like a super-element and connected to the rest of the model trough the boundary nodes, defined during the FEM modeling, moreover the multi-body tools, uses the modal shapes to reproduce the dynamic deformation of the leaf spring.

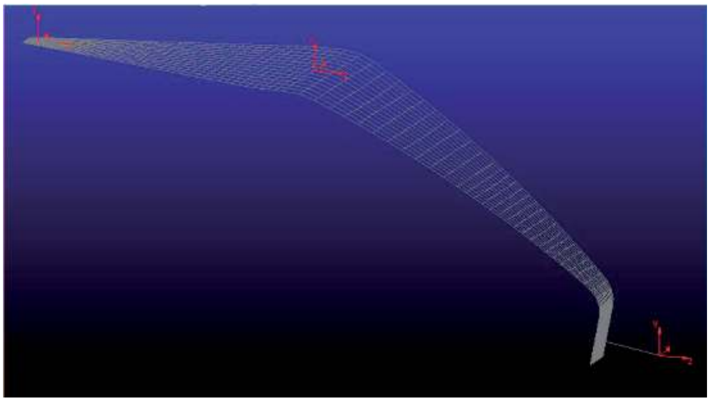


Fig. 8. Spring leaf model in ADAMS

As stated above, the spring leaf is connected to the fuselage in two positions trough different types of joints. In MSC.ADAMS several types of joints are available. Through the usage of connectors is possible to recreate the connections between the different parts of the model like in the real structure.

Regarding the studied case, the double hinge at the root of the spring leaf had been modeled with a 3D hinge, ball and socket joint, (Figure 9), respecting the distance between rotation axis and spring leaf present in the physical structure.

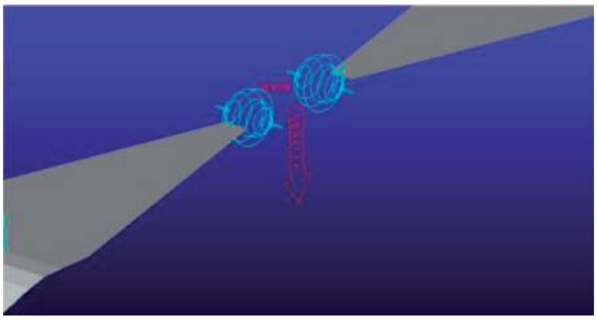


Fig. 9. Zoom of the joint at the root of the spring leaf

The frame support located at 50 cm from the root of the leaf spring has been modeled with a 1D hinge, in order to allow only the deflection of the leaf spring.

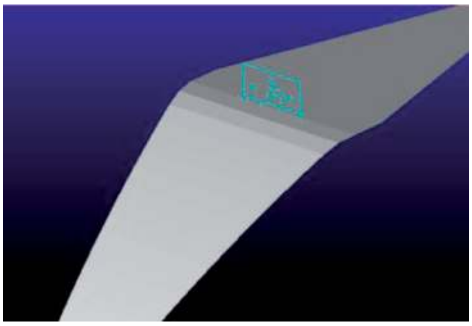


Fig. 10. Zoom of the support at the half of the spring leaf

Finally, the connection between the linchpin (modeled as a rigid element) and the tire had been realized with a 1D hinge (cylindrical hinge) that allows only the rotation of the tire around its main axis.

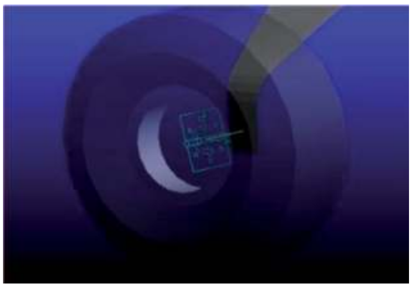


Fig. 11. Zoom on the joint between linchpin and tire

4.2. Tire and road definition in ADAMS

The dynamic behavior of the landing gear during the drop-test are strongly influenced by the interaction between tires and ground, for this reason an accurate modeling of these two parts is very important.

Besides helping to provide a smooth ride, the function of a pneumatic tire is to transmit forces and moments in three mutually perpendicular directions for vehicle direction control. A great number of tests and mathematical models have been developed to understand and predict the behavior of a tire [18]. In literature these models are classified in four groups: complex physical model, simple physical model, similarity methods and model based only on experimental data (so called empirical model) [19].

Physical model are addressed to model tire performance rather than its behavior in relation to the dynamic of the vehicle. This type of models has parameters such as materials, construction, geometry, tread design, loads. In particular complex physical models generally use finite element modeling techniques. Finite elements models of the tire are of particular interest when considering the interaction between the tire and road irregularities and for investigation between the road and the tire within the footprint of the tire [20].

Model based on similarity methods were useful early in the tire force model development process but they have found less use recently as they have been superseded by utilities given by other models [19].

The two remaining model classifications are the simple physical model and the empirical models. They relate the physical and kinematic properties of tires to the development of forces at the contact between tire and the roadway surface. In particular one of the most used simple physical model is the brush one. Brush models have been improved and developed over the recent years [21] but have not yet found their way in many dynamic simulation programs.

The remaining tire model class is the empirical model. This type of models employs mathematical functions capable of emulating the highly non linear behavior of the force generated by the tires. These mathematical functions can range from straight line segment approximations to nonlinear functions that contain numerous coefficients based on experimental data. This type of models is widespread in the vehicle dynamics simulation software. In the empirical models, the longitudinal tire force typically is mathematically expressed as a function of a variable called slip ratio. The lateral tire force typically is mathematically expressed as a function of a variable called slip angle. A third, distinct, feature of these models is the method of properly combining these two forces components for conditions of combined slip ratio and slip angle. Empirical models generally neglect effects such as self-aligning torque, camber steer, ply steer.

The chosen tire model is the FIALA one [22] that in literature is often used for drop test simulation purposes. FIALA model uses some empirical relations to calculate the force generated between tire and ground. These mathematic relations are function of slip ratio and slip angle. The background of the FIALA tire model is a physical tire model in fact analytical relations are derived from a physical tire model where carcass is modeled as a beam on elastic foundation. Elastic brush elements provide the contact between carcass and road.

The only available experimental and technical information about the type of tire used during the tests are the load-deflection curves (dependent from the inflation pressure that is 54 PSI for the studied case) and some geometrical and technical features. Parameters which mostly influence results of the simulations are the vertical damping (the stiffness depends on the inflation pressure), and the tire and ground friction's parameters. The solver used a specific equation to calculate the friction coefficient:

$$U = U_{max} - (U_{max} - U_{min})\, S_S\alpha \tag{1}$$

where:
U_{max} and U_{min} are the friction coefficients respectively in conditions of null slip ratio and slip ratio equal to one, $S_S\alpha$ is the comprehensive slip, defined as:

$$S_S\alpha = \sqrt{S_S^2 + (\tan\alpha)^2} \tag{2}$$

where S_S and α are respectively the slip ratio and the slip angle. It is important to remember that the slip ratio S_S is given by:

$$S_S = -\frac{V_x - r_e}{V_x} \tag{3}$$

where V_x is the longitudinal component of the total velocity vector V of the wheel center and r_e is the effective rolling radius. Finally the slip angle α is the angle formed between the direction of velocity vector of the center of the tire contact patch and the ISO-W x axis (this axis is defined as the intersection of the wheel plane and the local road plane) [22].

The value for these parameters was initially chosen by reference values, selected in relation to the physical experimental conditions; afterwards, considering that there is real rate of indetermination work of tuning has been carried out to find out the values that give back a good numerical/experimental correlation.

All the tire's geometrical and technical parameters must be defined in a text file with a specific format accepted by ADAMS, while tire's mass properties and location must be specified in the ADAMS/tire tab.

Regarding the road construction, besides the geometrical information, for the chosen model of road, only the correction factor for the friction coefficient, "mu" must be defined. This factor is multiplied for the coefficient of friction U defined before; the result is the final friction coefficient acting between tire and road. To simulate the presence of lubricated wedges, the chosen value for mu has been found out thanks to the work of tuning mentioned before [23].

4.3. Pantograph modeling

The pantograph model is based on the technical scheme reported in Figure 2 and on the table present in [17], shown in Figure 12, where the dimensions of each part of the structure are reported.

ELEMENTI	DATI SEZIONE (mm)	SEZ. (mm²)	LUNGHEZZA (mm)	DIST.* (mm)	PESO (Kp)	MOMENTO STATICO (Kp·m)	MOMENTO D'INERZIA (Kp·m²)
1	□ 120×40 ×3	924	3515	1685	25.30	42.63	95.77
2	□ 120×40 ×3	924	3515	1685	25.30	42.63	95.77
3	□ 120×40 ×3	924	3387	1685	24.40	41.10	92.36
4	□ 120×40 ×3	924	3387	1685	24.40	41.10	92.36
5	□ 120×40 ×3	924	1320	3300	9.50	31.35	103.46
6	□ 80×40 ×3	684	1200	3370	6.40	21.57	72.68
7	□ 80×40 ×3	684	770	3375	4.10	13.90	46.81
8	□ 40×30 ×3	384	750	3375	2.25	7.59	25.63
9	□ 40×30 ×3	384	750	3375	2.25	7.59	25.63

Fig. 12. Table with the pantograph components' characteristics

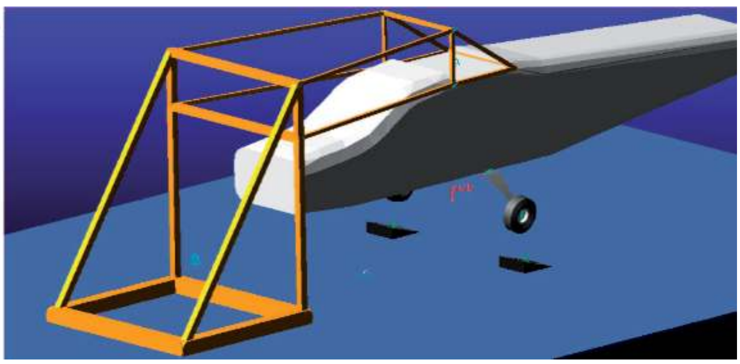


Fig. 13. Zoom on the pantograph model in ADAMS

The hinges that connect the pantograph's arms with the support fixed to the ground and the cage fixed to the fuselage had been modeled with a set of 1D hinges properly oriented. It has been made to simulate a dynamic of fall very close to the one obtained during the tests.

4.4. Simulations settings and results

The experimental tests, as stated above, had been carried out following the normative indications. These last impose weight and height of fall for the complex, depending from the maximum landing weight of the aircraft. In the model, the weight variation is obtained modifying the value of the concentrated mass, while the height of fall variation is obtained changing the initial rotational angle in one of the pantograph's hinges.

In the table below the simulations' results for different set-up are reported and compared with the respective experimental results.

Table 2.

Numerical/Experimental comparison

<table>
<tr><th colspan="9">Tire Damping = 9(N*sec)/mm mu = 0,15 C_alpha = 35N/deg UMIN = 1 UMAX = 1</th></tr>
<tr><th colspan="9">Table about Numerical/Experimental Drop test</th></tr>
<tr><th rowspan="2">Weight of the system (Max Load) (kg)</th><th rowspan="2">Height of falling (mm)</th><th rowspan="2">Angle of Chock (°)</th><th colspan="2">Load Factor</th><th>Diff. %</th><th colspan="2">Deflection</th><th>Diff. %</th></tr>
<tr><th>Experi-mental</th><th>Numeri-cal</th><th></th><th>Experi-mental</th><th>Numeri-cal</th><th></th></tr>
<tr><td>1774 (2470)</td><td>470 (Limit)</td><td>16</td><td>3,90</td><td>3,87</td><td>-0,8</td><td>360</td><td>329</td><td>-8,6</td></tr>
<tr><td>1774 (2470)</td><td>350</td><td>16</td><td>3,38</td><td>3,47</td><td>2,7</td><td>295</td><td>288</td><td>-2,4</td></tr>
<tr><td>1774 (2470)</td><td>250</td><td>16</td><td>2,90</td><td>3,12</td><td>7,6</td><td>225</td><td>250</td><td>11,1</td></tr>
<tr><td>1564 (2470)</td><td>677 (Reserve energy)</td><td>16</td><td>Not recorded</td><td>–</td><td>–</td><td>395</td><td>353</td><td>-10,6</td></tr>
<tr><td>1819 (2565)</td><td>470</td><td>18,5</td><td>4,15</td><td>3,83</td><td>-7,7</td><td>365</td><td>336</td><td>-7,9</td></tr>
</table>

Moreover, by the way of example, in the figures below are showed curves about acceleration and deflection, obtained by simulation and used to obtain results, reported in the Table 2 (in the particular case respectively rows n° 1 and 4) and the experimental curves, measured during the drop test.

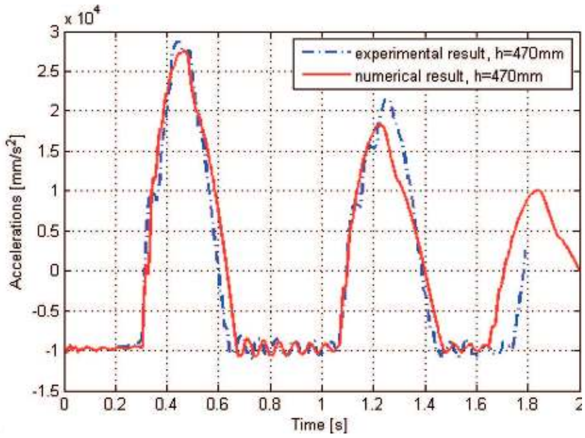


Fig. 14. Experimental/Numerical match about acceleration of CM (h. 470mm W. 2470Kg Limit Drop Test)

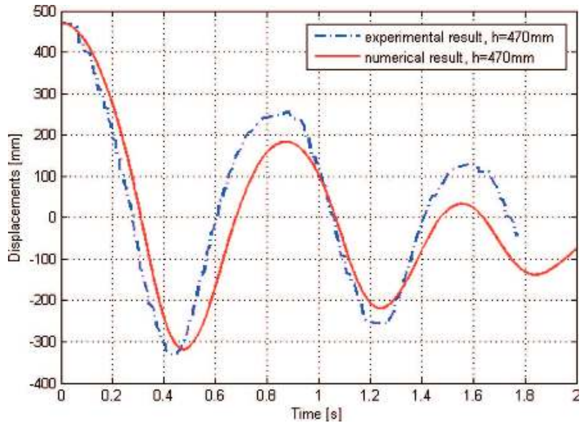


Fig. 15. Experimental/Numerical match about deflection of CM (h. 470mm W. 2470Kg Limit Drop Test)

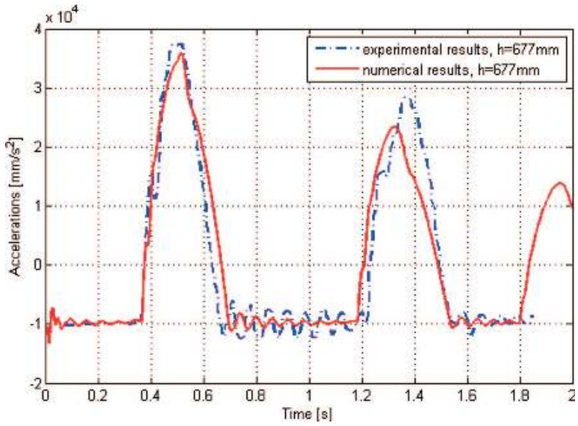


Fig. 16. Experimental/Numerical match about acceleration of CM (h. 677mm W. 2470Kg Reserve Energy Absorption Drop Test)

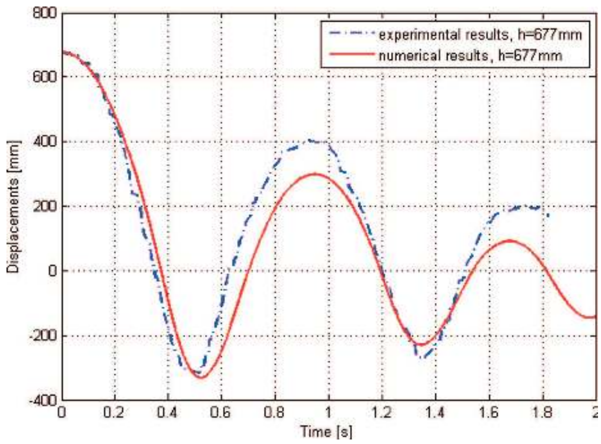


Fig. 17. Experimental/Numerical match about deflection of CM (h. 677mm W. 2470Kg Reserve Energy Absorption Drop Test)

5. Conclusions

This activity was aimed to reproduce the experimental results of the drop tests, conducted on the general aviation aircraft Partenavia AP.68TP-300 Spartacus via a multi-body simulation approach. The procedure followed to pursue the objective, starting from the geometric description of the problem, the FEM modeling and up to the final results obtained, was largely described in the previous sections. A validation of the structural stiffness of the leaf spring model through non-linear static simulations using Nastran solver were performed in order to correctly define the multi-body model. About the static deflections of leaf spring, the numerical results obtained via FEM, until medium-high loads, perfectly match compared with the experimental one. Increasing the load over 27kN the FEM simulations become less conservative, resulting in the higher rigidity of the entire landing gear. Then, the numerical leaf spring highlights higher stiffness compared with the real one. Once the multi-body model was realized a drop tests were simulated according to the *14 Code of Federal Regulation (CFR) Part 23*. The numerical results showed a percentage error variable from 1% to 11%, in terms of deflection and load factor. Based on these results the proposed methodology highlights an excellent reliability. In addition, the proposed approach results flexible and applicable to the main landing gear of any other general aviation aircraft.

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Zastosowanie metody układów wieloczłonowych do symulacji wypuszczania podwozia w samolocie

S t r e s z c z e n i e

Praca dotyczy efektywności analizy dynamicznej stałego podwozia samolotu wykonanej przy pomocy oprogramowania dla układu wieloczłonowego. Przedstawiono dowód zgodności między symulacją numeryczną a wynikami eksperymentalnych testów spadowych dla samolotu AP.68 TP-300.

Po wykonaniu makiet cyfrowych głównych części składowych podwozia w oprogramowaniu C.A.D. 3D, importowano je do środowiska ADAMS i zmontowano wirtualnie by odtworzyć rzeczywiste więzy. W środowisku ADAMS zrealizowano także model obiektu testowego.

Kadłub samolotu i podstawowe części podwozia zostały zamodelowane jako ciało sztywne. Jedynie resor piórowy i opona były symulowane jako ciała elastyczne. W symulacji wykorzystano model opony ze środowiska ADAMS dodając informację o podłożu z pliku danych drogowych. Opracowano symulacje mające odtworzyć przebieg doświadczalnego testu spadowego, scharakteryzowany przez określoną masę i wysokość spadku. Wyniki wykazały dobrą korelację między symulacją cyfrową i testem doświadczalnym, co stanowi wstępny dowód możliwości przyszłej redukcji kosztów dzięki wirtualnej certyfikacji nowych opracowań podwozi samolotowych.

Przyszły rozwój prowadzonych obecnie badań będzie prawdopodobnie iść w kierunku zastosowania tej metodologii do innych przypadków, co pozwoli na szerszą walidację mocy predykcyjnej metody. Będzie także opracowana wirtualna procedura certyfikacji.