compAct powerfUl anD reliAble piezoeleCtrIc acTuator for landing gear sYstems

Reporting

Project Information

AUDACITY

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Project website

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Project closed

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SOCIETAL CHALLENGES - Smart, Green And Integrated Transport

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€ 990 212,50

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€ 798 962,50

Coordinated by
CEDRAT TECHNOLOGIES SAS
France

Periodic Reporting for period 3 - AUDACITY (compAct powerfUl anD reliAble piezoeleCtrIc acTuator for landing gear sYstems)

Reporting period: 2021-04-01 to 2022-09-30

Summary of the context and overall objectives of the project

The objective of the AUDACITY project is to make the demonstration of a compact powerful and reliable piezoelectric actuator for future locking applications in landing gear systems, following the Clean Sky 2 program guidelines.

AUDACITY aims at impacting the competitiveness of Europe and Associated countries with the direct creation of 20 jobs and 45 Millions of cumulative sales before 2030.
The main objective is to develop and test a piezoelectric actuator, which
• has a power to mass ratio 10 times higher than the SoA
• has to be reliable under the heavy environmental conditions, and the applied load.
That way, several technical challenges are solved, allowing the technology to be demonstrated as reliable for such kind of application.

Through the project realisation, the main objectives of the project have been validated.
The friction test campagin proved the durability and the good behaviour of the friction key elements.
The environmental test campaign validated the TRL4 demonstration of the actuator, which complies the main specification elements.
These results will help, as expected, to reduce the fuel burn reduction thanks to weight saving, reduce the quantity of hydraulic fluid (thus the leakages), and the maintenance costs.

Work performed from the beginning of the project to the end of the period covered by the report and main results achieved so far

The work performed since the beginning of the project is detailed here after.

A initial trade-off of concepts has been made with 7 concepts evaluated where initially 5 were forecast. It consisted of an evaluation of Inchworm actuators, completed with one backup resonant actuator, and one FSPA from CTEC. Two main concepts (inchworm) have been kept and pushed to preliminary design step plus one backup concept based on resonant piezo motor.

The next steps consisted of an analytical calculation of the two(2) chosen concepts plus the Backup one. The calculation performed validated the good theorical behaviour of the concepts regarding the force, speed and thermal stability performances.
The preliminary design with FEM of the two(2) chosen concepts have been performed. These analyses validated the mechanical consistency of the 3D models. Each step of actuation has been checked and validated regarding the stresses and deformations of the concepts.
In parallel, a preliminary study on the Electronic design action plan have been elaborated

To help choosing the best concept, a thermal model correlation with CTEC experimental thermal test results has been made, with materials data (Metals + piezo) identifications for electro-thermo-mechanical simulations. The preliminary thermo-mechanical simulations assessed the influence of heat transfer on structural mechanics with the calculation of the load transfer between clamps, for the whole temperature range. Amelioration propositions of the concepts, making them operational on the

required temperature range have been made, which helped to determinate the best candidate.
In parallel of these design activities, a study on the friction behavior of the mechanism have been performed. The extensive literature review of frictional tests on material pairs led to a preliminary list of material pairs suitable for the application in terms of friction coefficient and the selection of commercial solutions and suppliers for the focused materials. A tribometer has been adapted at UNIRM1 to perform a preliminary frictional test campaign.
A new tribometer has been designed, to test the selected material pairs under representative conditions of the real ones with the piezoelectric actuators.
After performing all these actions, a Preliminary Design Review has been held to validate the choice of the concept selected to the detailed design phase.

For the detailed design phase, an improved version of the selected concept has been developed. To validate the behavior of the concept, a thermal test campaign has been performed on CTEC actuators present in the AUDACITY concept. Those results has been shared with the CSEM to perform a more accurate iteration of the thermomechanical calculations. The friction tests has been performed on the 4 most promising frictional material pairs. Preliminary lifetime friction tests validated the behavior of the 2 best pairs, chosen for the full lifetime test.

During the last period, the AUDACITY actuator has been manufactured. A mechanical test bench has been designed and manufactured by the CSEM to perform the environmental loaded tests.
The assembly has been performed by CTEC and the acceptance tests of the actuator demonstrated the good behaviour in a laboratory environment.
The CSEM then performed the test campaign under the environmental conditions to demonstrate the actuator performances required in the project specification.

The test campagin showed good results with a compliance on all the performances expected.
The margin of improvement states in reducing the volume and mass of the actuator.

On the dissemitation point of view, the PEDR has been issued and submitted during the first reporting period. This document is in line with the plan for exploitation and dissemination of results as described in the DoA.
Outstanding W5 action:
Project management:
• KO meeting @ SAFRAN
• Intermediates meeting and visio conferences
• Project reporting

Disseminations and communications:
Web and blog pages created on CEDRAT website
• CTEC has updated piezo motor training course thanks to the concepts
• Abstract submitted at ACTUATOR CONFERENCE 2020 DE (but postponed by COVID in feb 2021)
• Project leaflet designed
• Social media

• Motor technology leaflet available on web page
• ACTUATOR 2022 Scheduled in June 2022: Paper Submitted / ORAL PRESENTATION.: High power density Piezo motors for critical environments, E. Betsch and al, ACTUATOR2022_conference_
• CTEC Video of AUDACITY Actuator : https://www.youtube.com/watch?v=JvY9KM5u828&ab_channel=CEDRATTECHNOLOGIES
• Conferences, Papers:
- E. Betsch, J. Gauthier, N. Bencheikh, A Pagès, High power density Piezo motors for critical environments, ACTUATOR 2022 •
- Ciprari, S., Tonazzi, D., Lazzari, A., Saulot, A., and Massi, F., 'Identification of dynamic contact instabilities generated by braking materials', ISMA 2022
• Presentation to French aerospace cluster
• Emailing to >1000 CEDRAT Prospects
• The prototype in the CEDRAT' show room now

National Aerospace clusters publication: http://www.aerospace-cluster.fr/news-entreprises/lindustrie-aeronautique-innove-en-auvergne-rhone-alpes/

Progress beyond the state of the art and expected potential impact (including the socio-economic impact and the wider societal implications of the project so far)

Audacity is required to get rid of the well-established hydraulic actuators in order to comply with System ITD Strategic Objectives in terms of environmental impact and More Electric Aircraft (MAE). The technical objective is then to integrate all the technical progresses within a prototype for TRL4 demonstration.

The contribution to High level goals achieved through the project are the following :
- Reduction of full burn thanks to weight saving
Improving the power density factor of the actuator lead to weight saving

- Less hydraulic: no leakage and less pollution
No oil change = less pollution

- Maintenance cost reduction
Maintenance free actuator in designing a 100% electric actuation and 0% hydraulic.
The AUDACITY project developed a maintenance free fully electric piezo actuator, and then contribute to strengthen the
Aircraft Industry European competitiveness.

audacity-act.jpg

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Permalink: https://cordis.europa.eu/project/id/831795/reporting