

NASA's Bio-inspired Broadband Acoustic Absorber: Experiences at the 2021 FedTech Startup Studio

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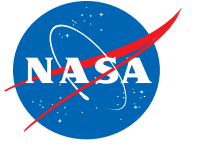
NASA Glenn Acoustics Branch

Hybrid Acoustics Technical Working Group Meeting

April 12-13, 2022

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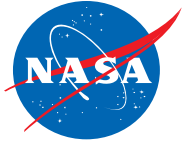
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Outline

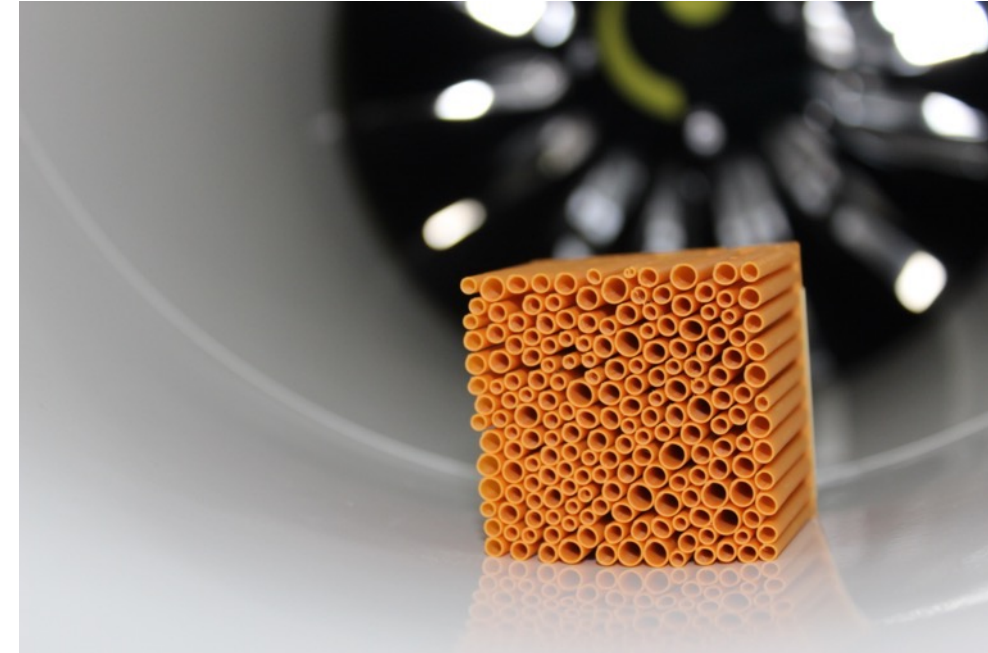
- Overview: Executive Summary Slide
- Who cares?
- Description of the Bio-inspired Broadband Acoustic Absorber ('Bioliner')
- Inventor perspective from the 2021 FedTech Startup Studio
- Resources from NASA's Technology Transfer Program
- Educational Outreach Resources
- Conclusion
- Acknowledgements
- References

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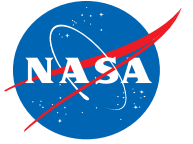
Overview: Executive Summary

- Motivated by the need to reduce aircraft engine noise, NASA's Bio-inspired Broadband Acoustic Absorber ("Bioliner") is patented technology that can be developed into multifunctional structures that can absorb sound and might also transfer heat and/or carry a load.
- Bioliner was one of 12 technologies from federal and university labs that were selected for the FedTech Startup Studio 2021:¹
 - National Aeronautics and Space Administration (NASA),^{2,3}
 - National Institute of Standards and Technology (NIST),⁴
 - National Nuclear Security Administration (NNSA),⁵ and
 - Northeastern University⁶
- From August to December 2021, FedTech coached teams of entrepreneurs who explored the commercial potential of the bioliner by performing customer discovery interviews.
- Results of that investigation supported the claim that the bioliner might have broad commercial potential, beyond aerospace use.



A sample of the bioliner placed in the NASA GRC DGEN Aero propulsion Research Turbofan inlet⁷

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Who Cares?

“We’ve built a society that is completely dependent on technology.”
Humanity from Space, PBS⁸

At NASA we are asking: How might we develop a commercial air transportation system accessible to a growing population that is safer and cleaner and quieter than the one that exists today?

What you can learn from this presentation:

NASA: our recent progress maturing the bioliner

Other Government Organizations: a tech transfer example

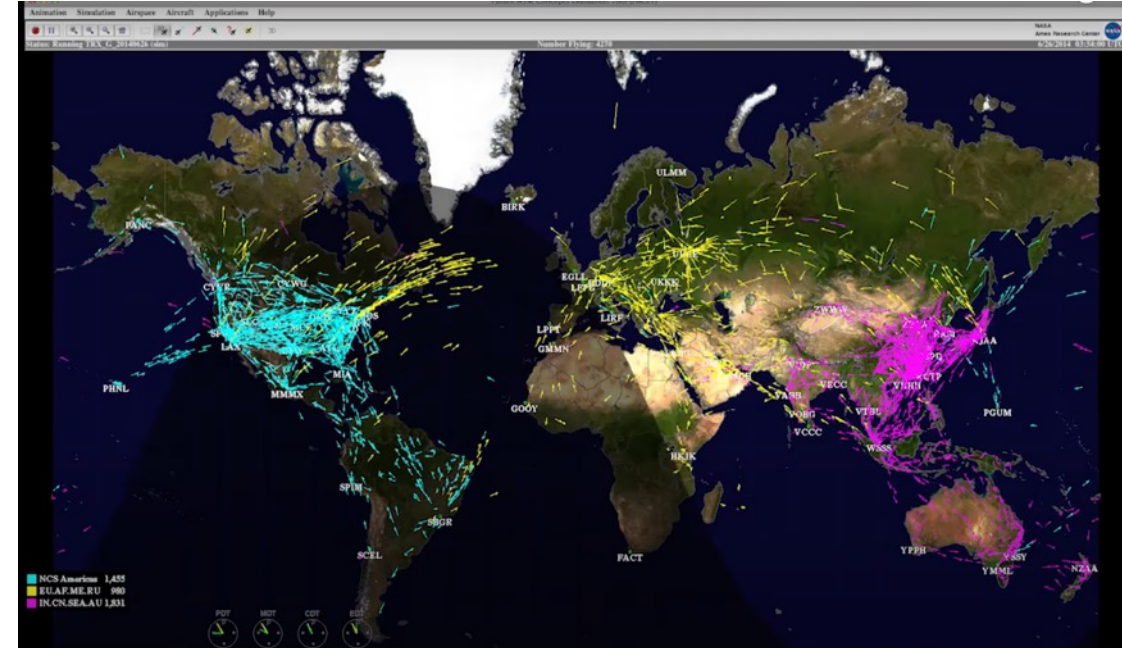
Existing Businesses: new technology to help stay competitive

Entrepreneurs: resources to help you launch a tech startup

Educators: resources to introduce new technology to your students; resources for university inventors and entrepreneurs

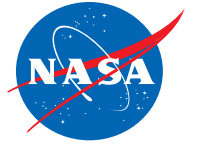
Students: ways to apply your sharp new engineering skills and personal interests to help bring noise reduction concepts into service

Public: we’ll need everyone’s help to increase the peace and quiet in the world



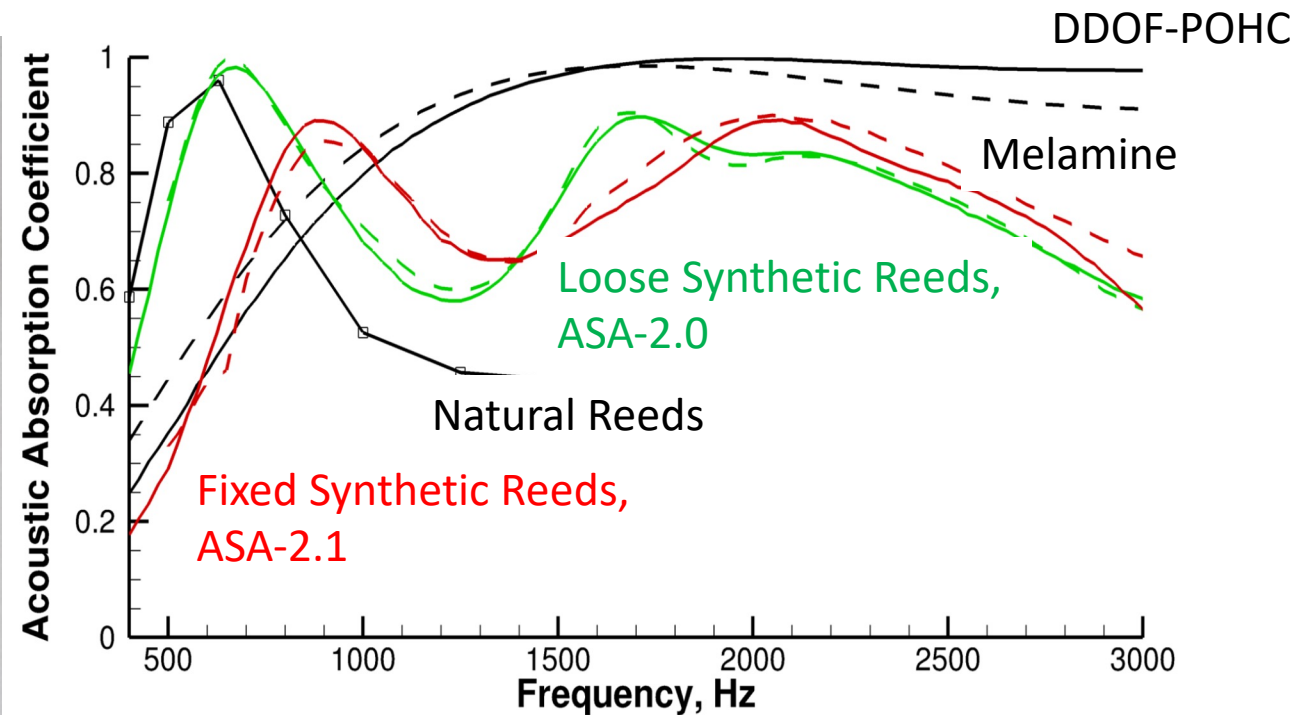
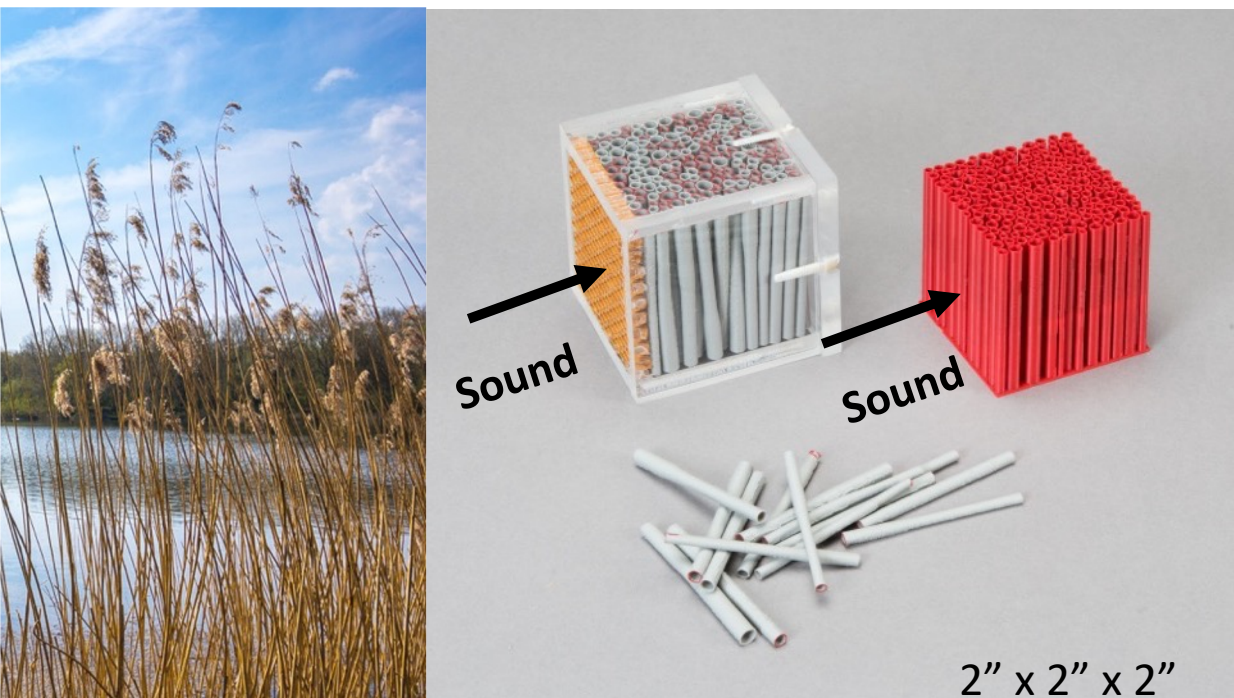
**A still image from the animation of
NASA's Future Air Traffic Management
Concepts Evaluation Tool (FACET)-Global⁹**

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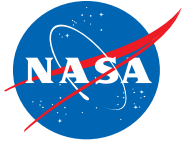


Technology Description

Proof-of-concept tests demonstrated that synthetic structures that resemble bundles of natural reeds offer an increase in sound absorption at frequencies below 1000 Hz compared to state-of-the-art commercially available structures of similar thickness, volume, and weight. More information is available in our most recent reports, References 10 and 11.



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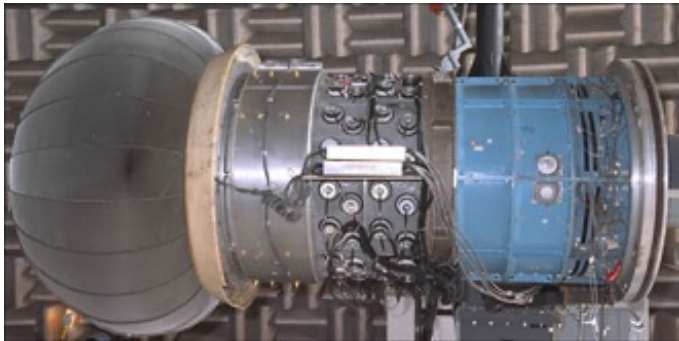
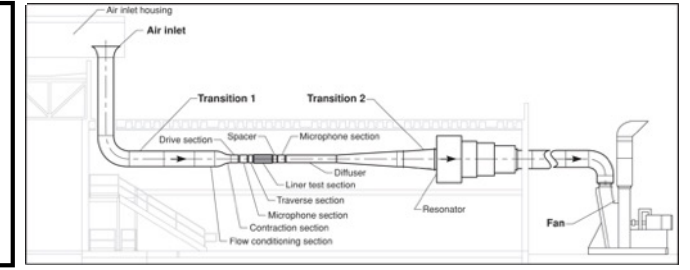
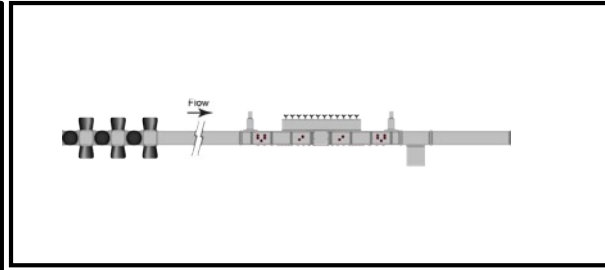
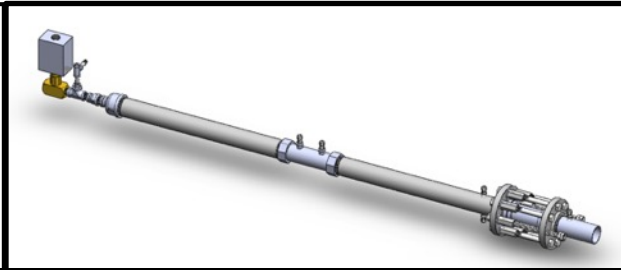
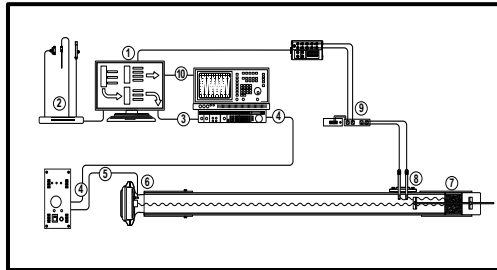
There are many acoustic tests that can be performed to mature this technology for use on aircraft, ranging from bench tests to flight tests.

Impedance Tube

Flow Resistivity Rig

Grazing Flow Incidence Tube

Curved Duct Rig



Advanced Noise Control Fan



DGEN 380



Fan in 9'x15' LSWT

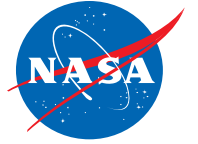


Engine Ground Test

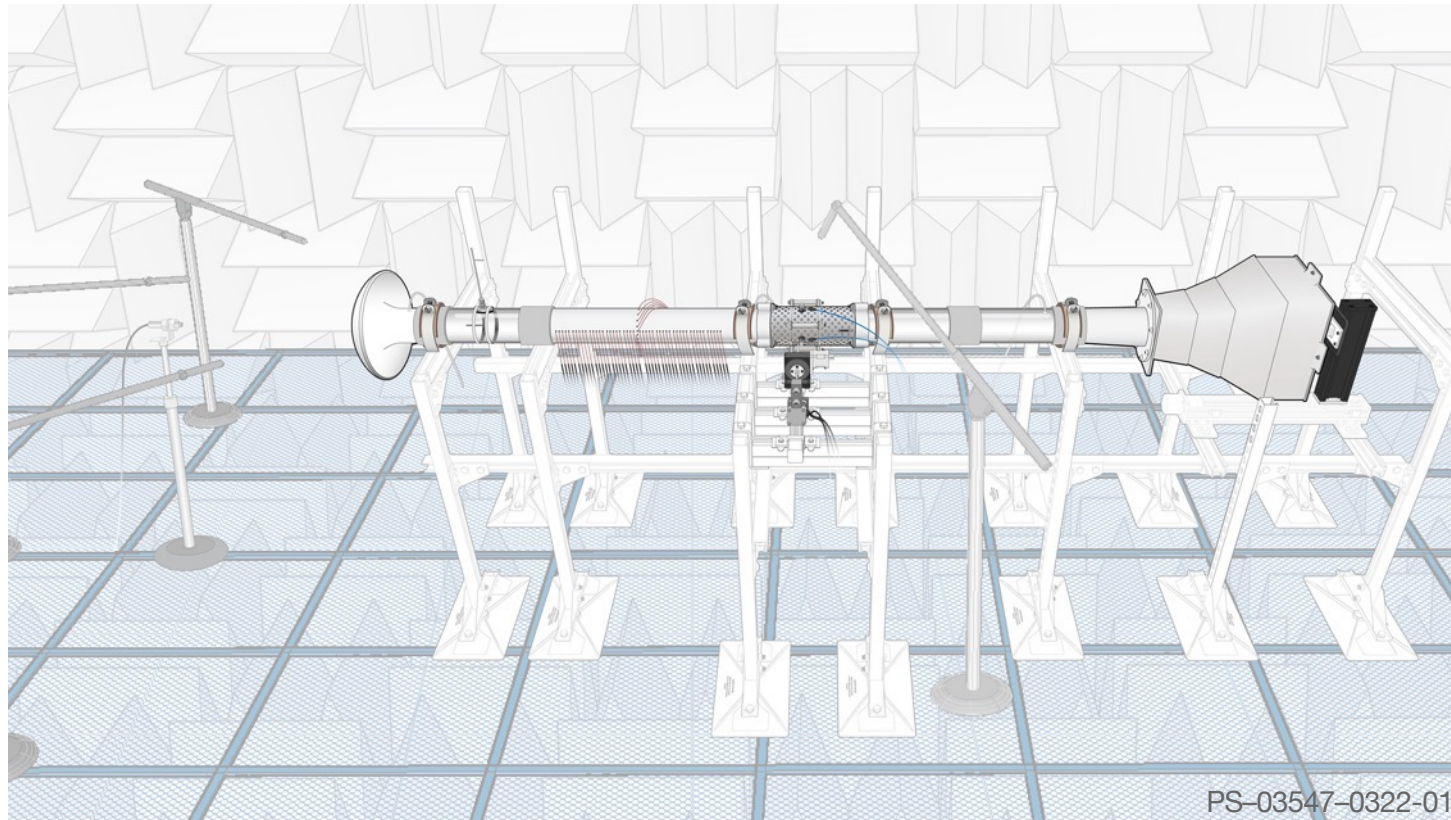


Flight Test

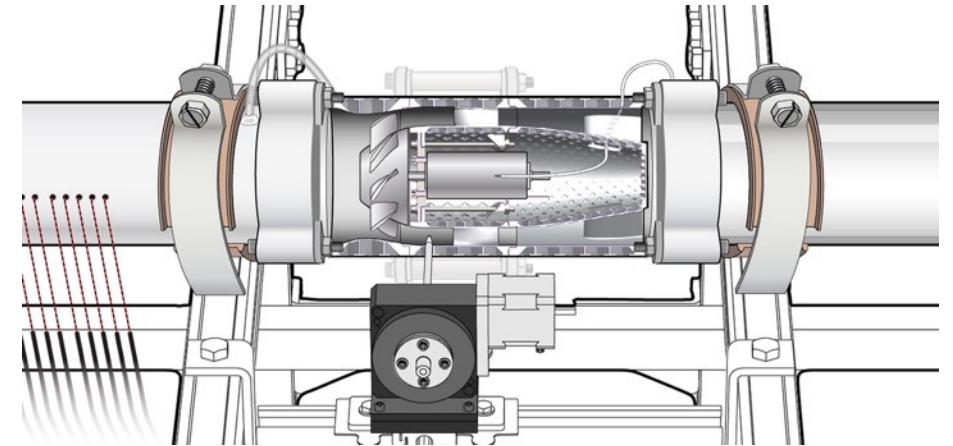
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Additionally, we built a new rig during the pandemic that can be used mature this technology for aerospace use: **The NASA GRC Small Fan Aeroacoustic Test Rig^{12, 13}**



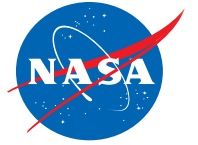
PS-03547-0322-01



PS-03547-0322-05

A spacecraft cabin vent fan prototype was recently tested in the Small Fan Aeroacoustic Test Rig;
(on left) rig installed in the NASA GRC Acoustical Testing Laboratory;
(above) cutaway of fan with hotwire and inlet microphone array.

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Inventor Perspective

- Inventor teams were paired with entrepreneurs, and FedTech mentors and coaches for 16 weeks, August – December 2021.
- Entrepreneurs volunteered 20 hours per week during evening and weekend hours in exchange for information about this technology, lean startup principles, and the basics of licensing from and partnering with federal laboratories.
- Inventors were expected to attend a virtual kickoff meeting and participation in all other online weekly meetings with the entrepreneurs and FedTech was optional.
- Entrepreneurs drafted a business plan and conducted customer use surveys to assess commercial potential of the patented technology.

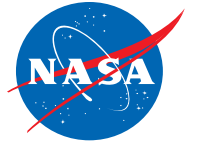
FedTech Startup Studio Launches NASA-Tech-Based Startups

The 16-week [Startup Studio](#) kicked off on August 12, 2021, with a cohort that featured technologies from nine federal laboratories, including three NASA Field Centers. The second phase concluded on December 9, 2021, with the [Frontier Venture Summit](#), a culmination of FedTech's Startup Studio program featuring finalist pitches, a keynote speaker, and a vote for the best startup pitch.



[FedTech Startup Studio Launches NASA-Tech-Based Startups summary posted online.](#)³

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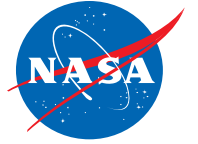
Inventor Perspective

- The FedTech Startup Studios ended with a virtual Pitch Day event on December 9, 2021. Entrepreneur teams presented their business plans to representatives from the federal labs, FedTech staff, and an investor panel. Deliverables to NASA include a final report and copies of entrepreneur pitch day videos.
- FedTech does judge the entrepreneur pitches, and the winner this year was offered some continued support as they try to start new companies and license technologies from the labs.



[A recap video from the 2020 NASA FedTech Startup Studio has been posted online and linked here.](#)¹⁴

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NASA's Technology Transfer Resources

- NASA's Tech Transfer Office is sharing news about NASA's patented technology funded through NASA's **T2X** and **T2U** programs.
- NASA's T2X program reaches out to entrepreneurs and startups to help them discover NASA's portfolio of technology available for license. The bioliner's FedTech experience was provided by the T2X program.
- NASA's T2U program reaches out to universities. For example, students studying business and engineering at the University of Tennessee and the University of Alabama have been considering the bioliner in their undergraduate capstone projects.

For more information on this and other technologies available for license, contact a NASA Glenn Technology Manager



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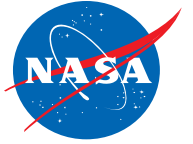


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Partnering with NASA:

License NASA's Patents

- NASA's patents can be browsed on the Technology Transfer Program website: technology.nasa.gov
- Patents are sorted into industrially relevant categories
- Licenses come with a variety of terms depending on intended use:
 - Research license: allows licensee to "test drive" commercial viability of NASA's technologies with minimal risk
 - Government use license: allows licensee to leverage NASA technologies for government funded projects
 - Commercial license: Secure rights to make and sell products based on NASA technologies

Use NASA's Software

- NASA's software can be accessed and used for no cost via a Software Usage Agreement
- To search NASA's available software, visit the NASA Software website: software.nasa.gov

Access NASA's Facilities and Subject Matter Experts

- NASA can participate in cooperative research and development using the Space Act Agreement (SAA)
- SAAs are individually negotiated



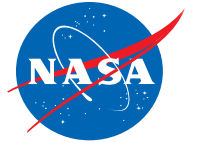
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grc-techtransfer@mail.nasa.gov

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Aerospace Research Mission Directorate (ARMD):
Engage with NASA's ARMD through current and forthcoming programs and solicitations:
<https://www.nasa.gov/aeroresearch>
University Student Research Challenges (USRC)
NASA Aeronautics Design Challenge

Space Technology Mission Directorate (STMD): University Focused Opportunities
Engage with NASA's STMD through current and forthcoming solicitations or opportunities:
<https://www.nasa.gov/directorates/spacetech/solicitations>

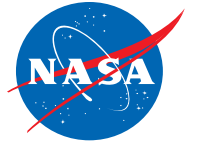
Opportunities specifically for universities fall under Space Technology Research Grants (STRG), specifically:

- NASA Space Technology Graduate Research Opportunities (NSTGRO)
- Early Career Faculty (ECF)
- Early-Stage Innovations (ESI)
- Lunar Surface Technology Research (LuSTR)
- Space Technology Research Institutes (STRI)-open

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Outreach Resources

The bioliner project and team have been very visible to the global public:

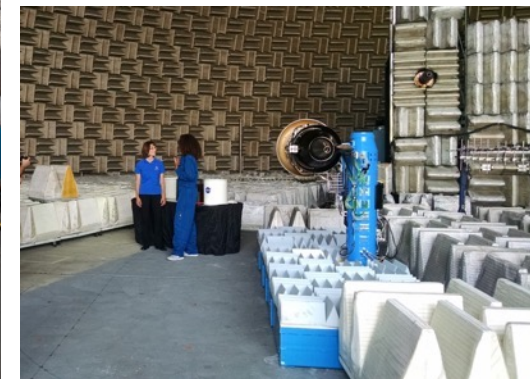
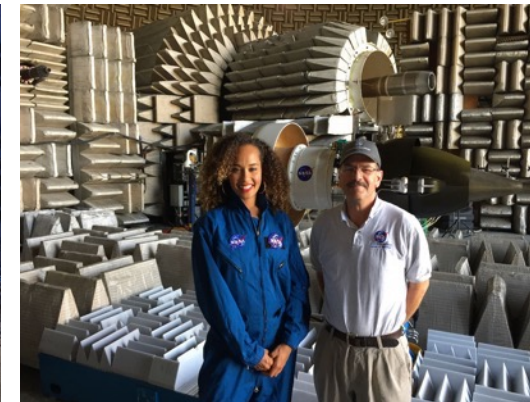
[Xploration Nature Knows Best video interview](#) ¹⁵

[NASA GRC High School Capstone Projects](#) ¹⁶

One of the most popular projects since 2017. Jerry Voltz from NASA's Office of Education leads this activity supported by Subject Matter Experts Chris Johnston and Maria Kuczmariski.

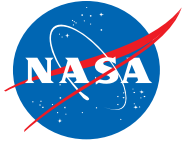
[NASA ARMD Leveled Reader Series](#) ¹⁷

April Lanotte prepared a three biographies of Danielle Koch describing NASA research, the bioliner, and aerospace engineering careers for people learning how to read English.



Xploration Nature Knows Best host Danni Washington and NASA engineers Dan Sutliff and Danielle Koch in the AeroAcoustic Propulsion Laboratory with the DGEN Aeropropulsion Research Turbofan.

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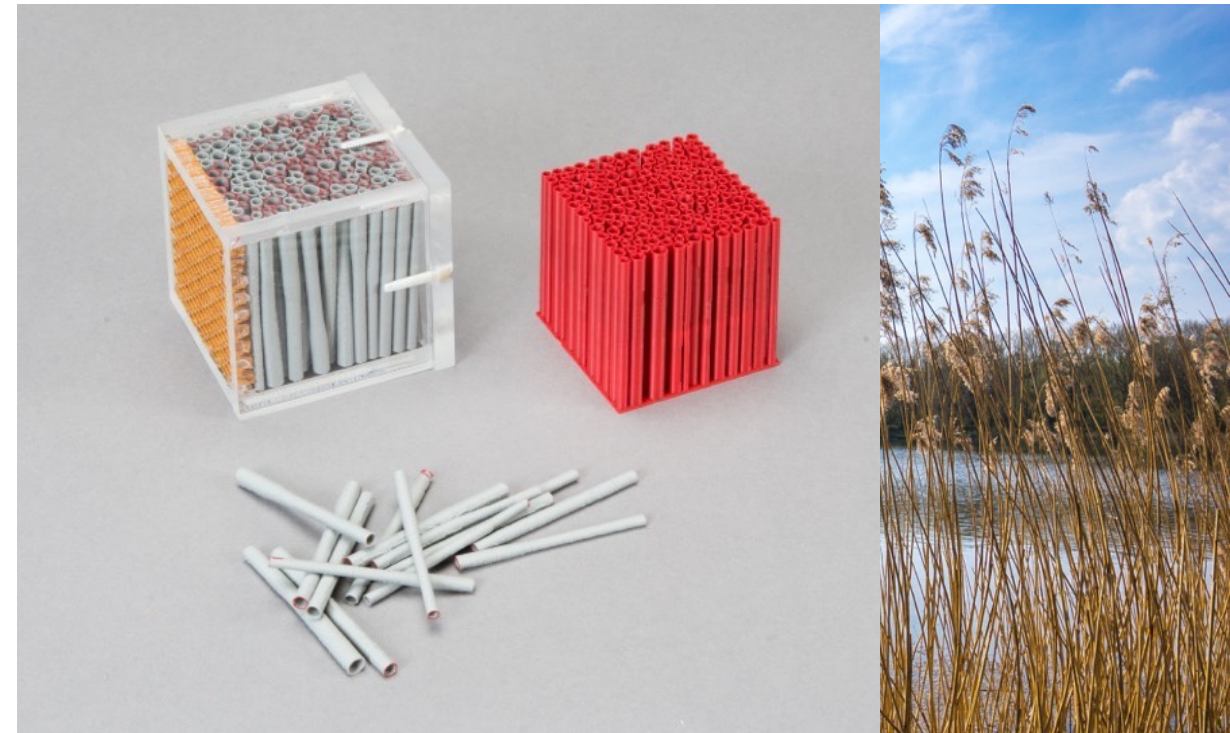
Conclusion

NASA's Bio-inspired Broadband Acoustic Absorber ("Bioliner") is patented technology that can be developed into multifunctional structures that can absorb sound and might also transfer heat and/or carry a load.

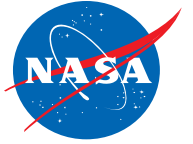
Bioliner was one of 12 technologies from federal and university labs that were selected for the FedTech Startup Studio 2021.

Results of that investigation supported the claim that the bioliner might have broad commercial potential, beyond aerospace use.

The Startup Studio was only one of the ways that NASA Technology Transfer Team is reaching out to entrepreneurs.



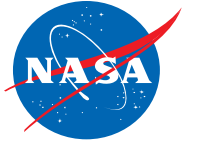
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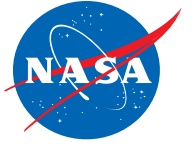
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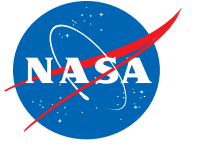
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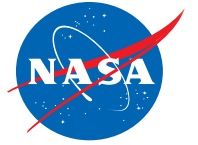
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Acknowledgements

NASA Glenn Team

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