STRUCTURAL FRAME FOR IMPINGEMENT NOISE REDUCTION

IITM Technology Available for Licensing

Problem Statement

- **Impingement noise** is a concern in **vertical aircraft systems (VTOL), Thrust reducer, rocket launching, machining processes**, and similar applications.
- Existing methods have limitations in reducing impingement noise without compromising other aspects.
- A **versatile solution** is needed to address both **subsonic and supersonic jets effectively**.
- The invention aims to **mitigate impingement noise** by **optimizing pressure drop across panels** while maintaining structural integrity.
- Provides an **efficient and adaptable noise reduction** approach for various scenarios.

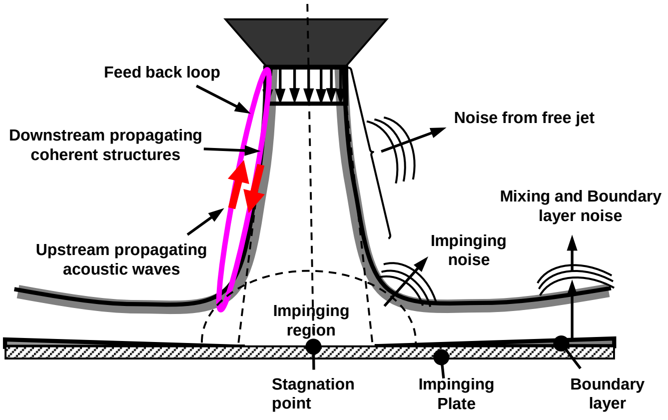

Fig.1 is a schematic representation of noise sources in one of the multiple uses where an embodiment of the invention can be used.

Technology Category/ Market

Category	Acoustics, Aeroacoustics, Noise control/Reduction Technology
Applications	Vertical Aircraft Systems, Thrust reducer of aircraft, Automotive, Rocket Launch Pads, Household Appliances
Industry	Aerospace and Aviation, Manufacturing and Industrial Processes, Rocket and Space Technology, Home Appliances and Consumer Electronics.
Market	Global Noise suppression Components, Market size was valued at $13.1Billion in 2021 and is poised to grow from $14.83 Billion in 2022 to $39.98 Billion by 2030, growing at a **CAGR of 13.2%** in the forecast period (2023-2030)

Technology

The key technology in this invention is the unique frame design with a heterogeneous grid that allows high-speed gas flow while reducing impinging jet noise.

The invention utilizes specific materials for different applications - high-temperature resistive concrete for aerospace, plastic for household and industrial use.

Effective for both subsonic and supersonic jets - reduces coherent structure impact for subsonic jets and mitigates shock oscillations for supersonic jets, reducing distinct tones.

The technology optimizes frame thickness and porosity to achieve desired noise reduction levels by controlling pressure drop.

Applicable in various fields, such as rocket launching, high-speed jet cutting, household appliances, and VTOL vehicles, offering noise reduction and power-saving benefits.

Applicable to reduce exhaust noise of automobiles and industrial process plants etc;

Key Features / Value Proposition

- High-temperature **resistive porous panel** with a heterogeneous grid structure.
- Effectively **reduces impingement noise** in both subsonic and supersonic jets, including broadband **turbulent mixing noise and distinct tonal noise.**
- **Versatile application** in vertical aircraft systems, high-speed machines, rocket launch pads, and household appliances.
- Optimizes **pressure drop** to **ensure noise reduction** without compromising airflow or structural integrity, **providing a cost-effective and efficient solution**.

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Results

Table 1 – Specifications of porous plates

Porous Plate				Resistance	
PPI	t (mm)	d_{pore} (mm)	ε	Inertial (α) (m^2/s)	Viscous (β) (1/m)
30	22	0.85	0.72	8.64×10^{-9}	299
20	22	1.25	0.74	1.00×10^{-9}	257
10	22	2.35	0.79	6.21×10^{-8}	64
10	50	2.30	0.77	4.16×10^{-8}	111

* PPI pore per inch t – thickness d_{pore} – pore diameter ε porosity

Forchheimer equation $$\frac{\Delta P}{t_h} = \frac{\mu}{\alpha} u + \beta \frac{\rho u^2}{2}$$

Using above equation and experimental data α and β are calculated for all plates and tabulated in Table 1.

OASPL Comparison

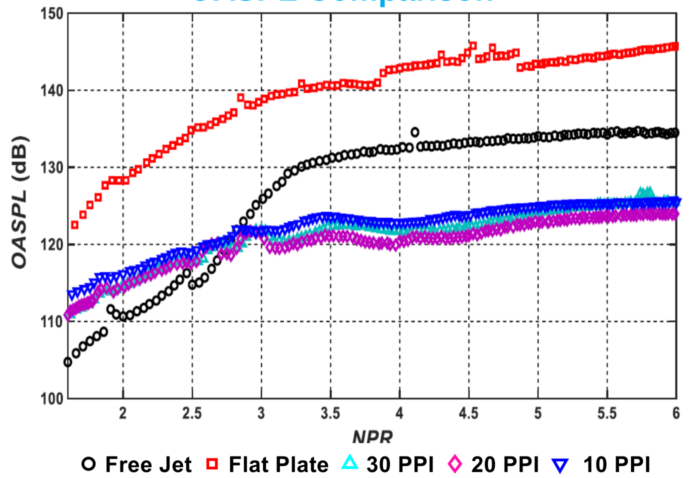

Fig.2 OASPL for free jet and impinging jet on impermeable plate and permeable plate (10, 20 and 30 PPI) located at h/d =5.0
Showing 10-20 dB reduction

Acoustic Power Comparison

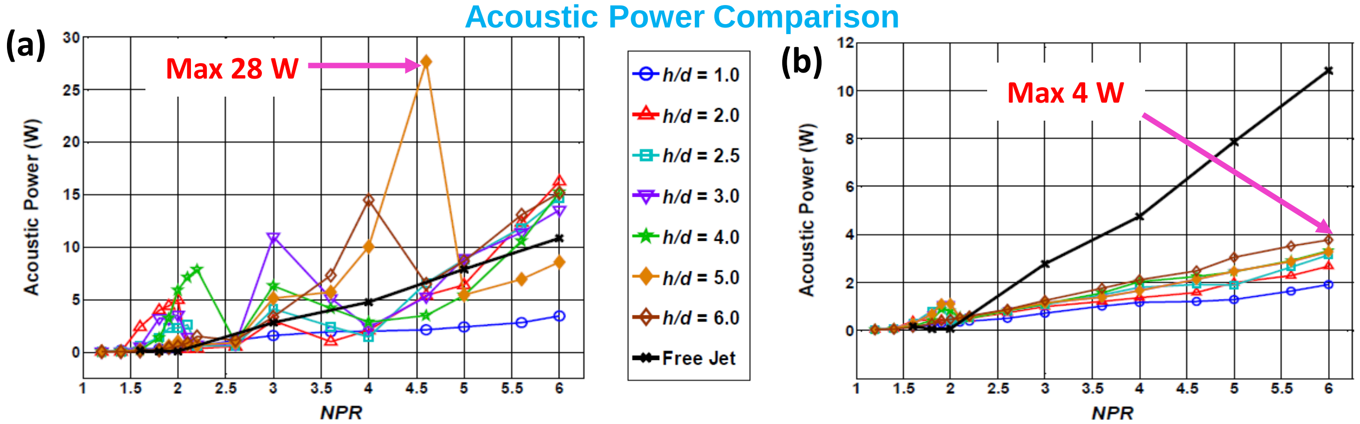

Fig.3 The acoustic power of impinging jet on (a) impermeable plate (b) permeable placed at various standoff distance (h/d) and NPR

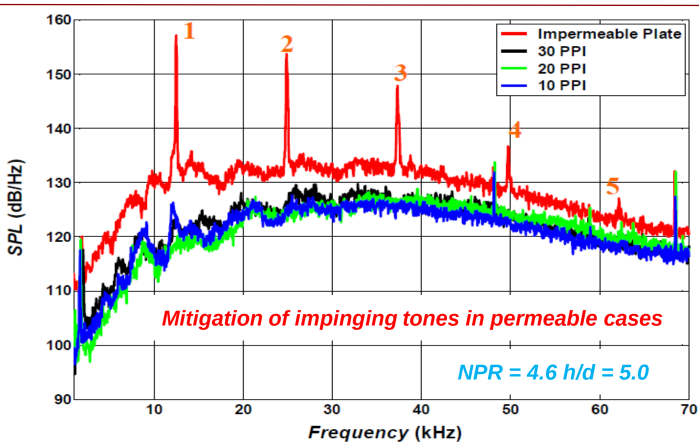

Fig. 4 SPL variation with frequency impinging jet on impermeable plate and permeable plates

Intellectual Property

- **IITM IDF Ref. 1349**
- **IN 434937 (PATENT GRANTED)**

TRL (Technology Readiness Level)

TRL- 3/4, Proof and concept validated

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