

# DEVICE FOR ELECTRICAL ENERGY HARVESTING FROM MECHANICAL VIBRATIONS

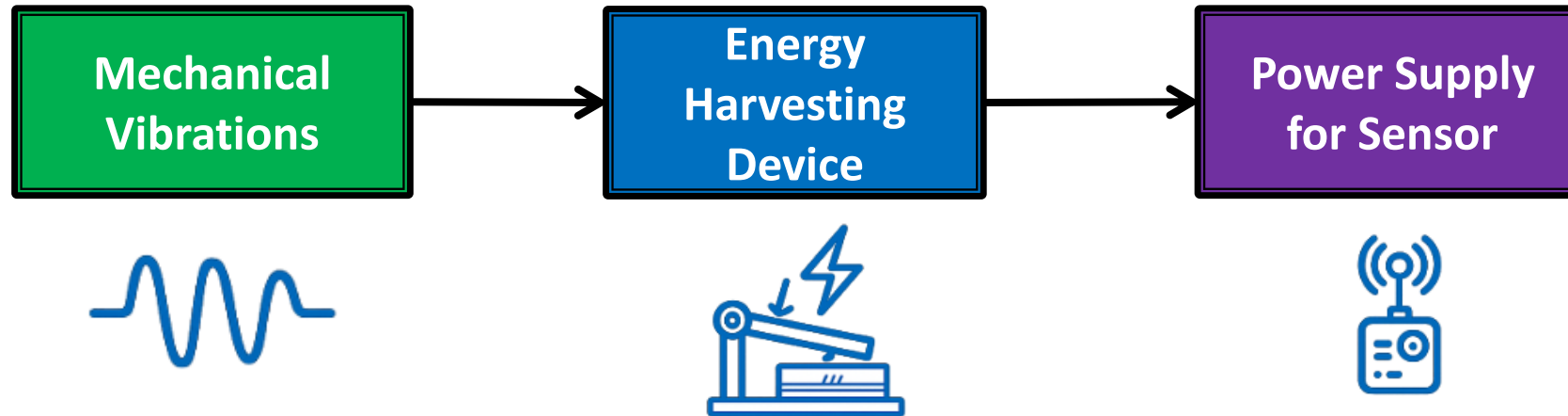
Bartłomiej Ambrożkiewicz<sup>a</sup>, Zbigniew Czyż<sup>b</sup>

<sup>a</sup>Lublin University of Technology  
Nadbystrzycka 36, Lublin 23-200, Poland

<sup>b</sup>Polish Air Force University,  
Dywizjony 303 35, Dęblin 08-521, Poland

# Problem & Market Need

- The number of autonomous sensors and monitoring systems is rapidly increasing,
- Batteries require periodic replacement and maintenance,
- Mechanical vibrations are widely available in the environment,
- Conventional piezoelectric systems do not use the full energy harvesting potential.



**The biggest problem with existing solutions is that the piezoelectric element does not bend uniformly, so only part of its length generates energy effectively.**

# What is the invention about?

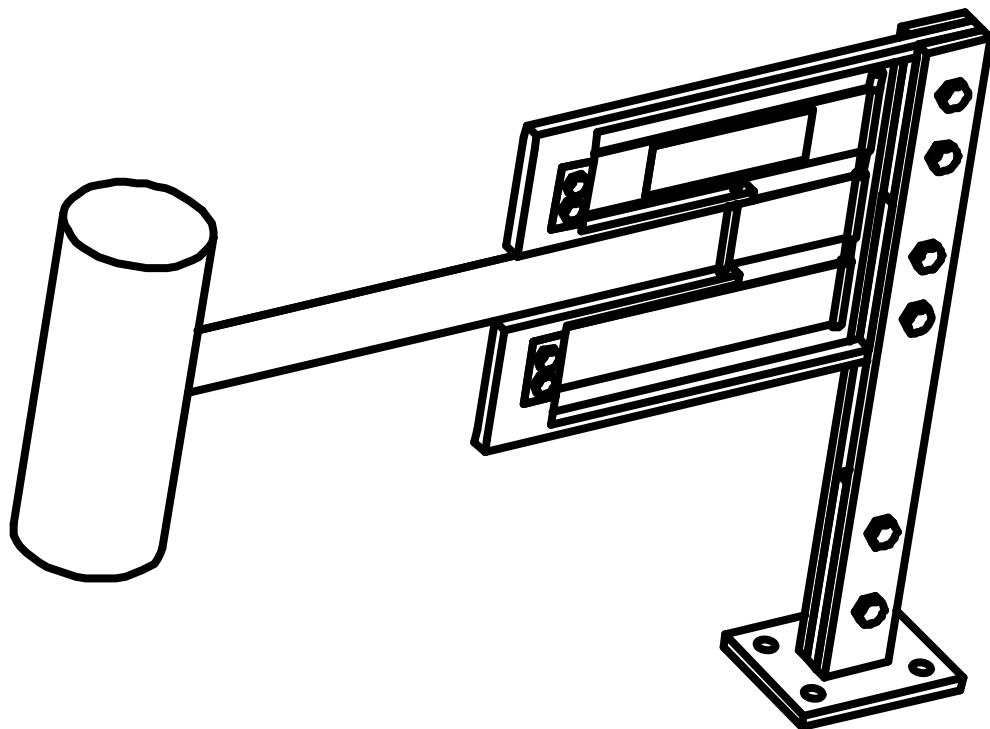


Fig.1 Initial configuration of the vibration energy harvester

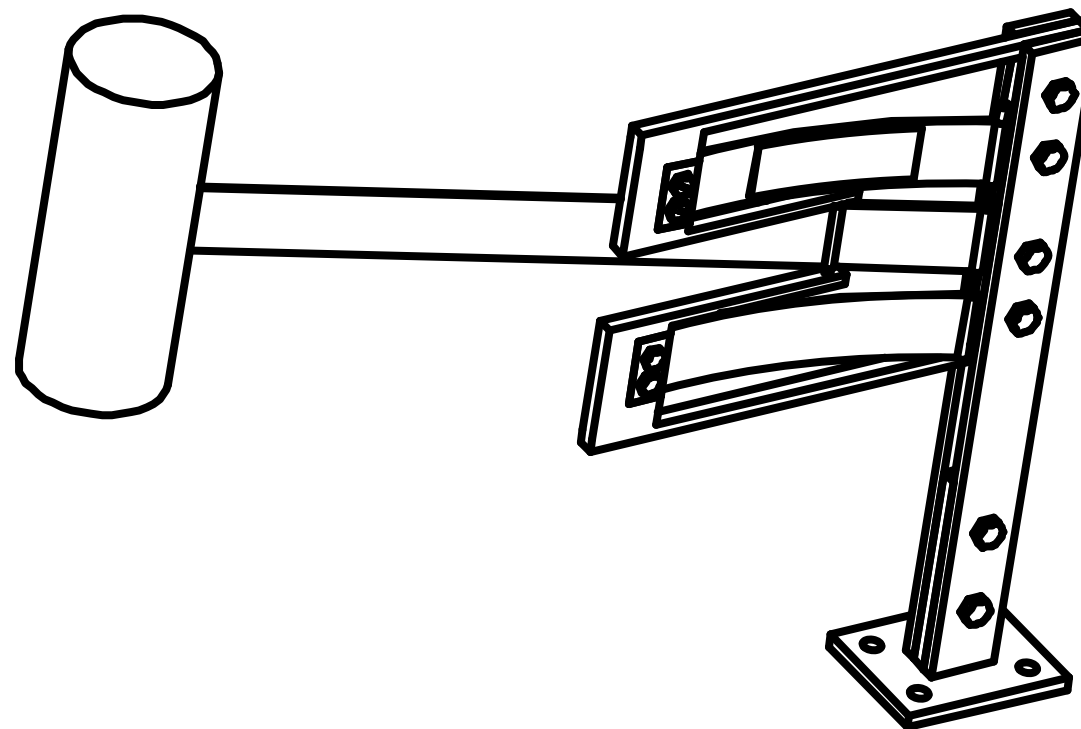


Fig.2 Deformed configuration with enhanced beam deflection

**Dedicated mechanical system amplifies motion and improves uniform bending of piezoelectric elements.**

# How does it work?

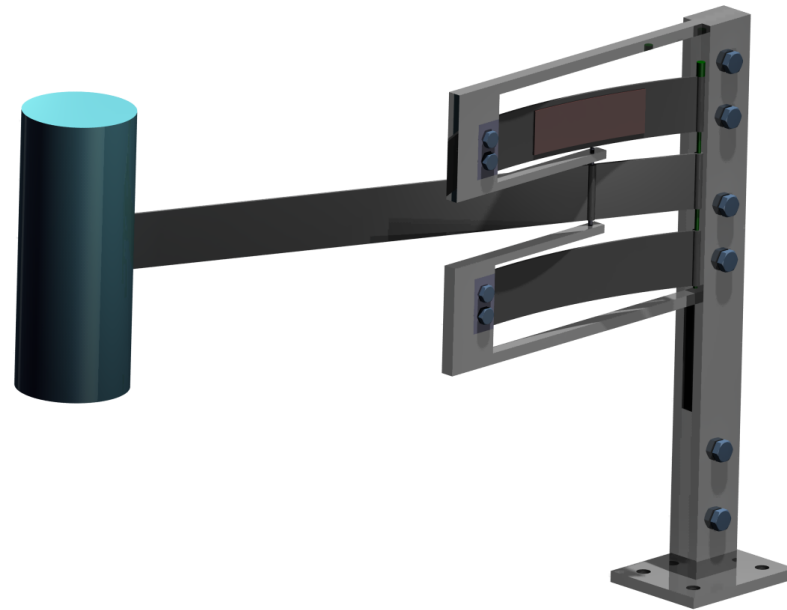
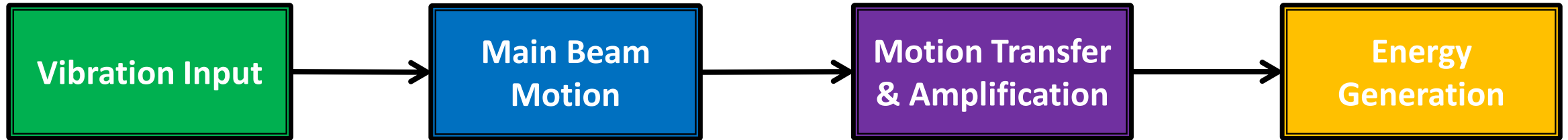


Fig.3 3D model of the developed vibration energy harvester

# What is innovative?

1. Uniform bending



2. Motion amplification



3. Higher electrical output



4. Stable mechanical operation



5. 2 Piezoelectric elements



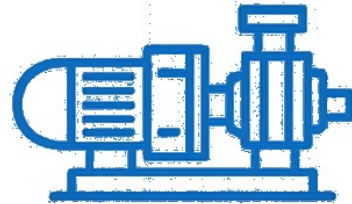
# Potential applications



Autonomous IoT sensors



Infrastructure monitoring



Machine diagnostics



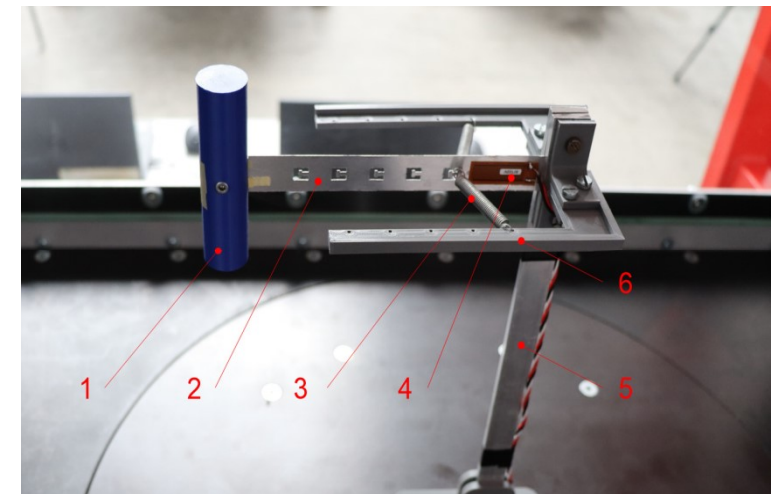
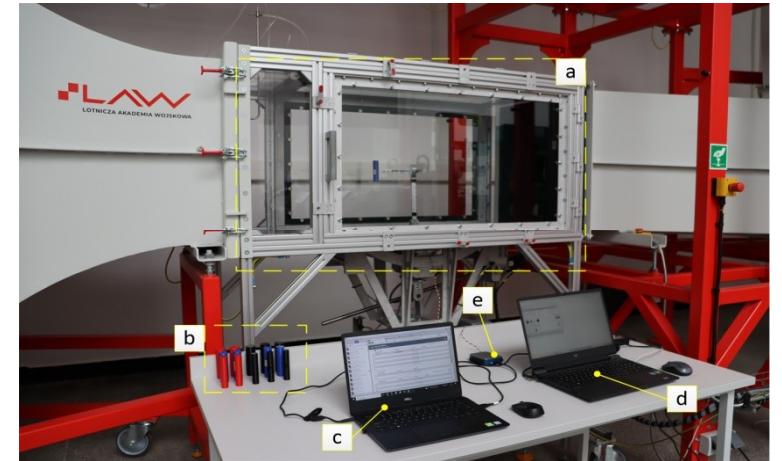
Distributed measurement systems

Fig.4 Application areas of the proposed vibration energy harvester

**From ambient vibrations to autonomous sensing.**

# Readiness level

1. Positive technical check, no. P451481
2. Prototype and 3D model prepared
3. Concept verified at the proof-of-principle level
4. Presented in scientific publications
5. Estimated TRL: 4



# Summary

1. The invention addresses the limited efficiency of conventional piezoelectric harvesters caused by non-uniform beam deformation.
2. The proposed mechanical arrangement improves motion amplification and bending uniformity of piezoelectric elements.
3. The solution increases the potential for electrical energy harvesting from ambient mechanical vibrations.
4. The concept can support autonomous sensors, monitoring devices, and low-power diagnostic systems.



# Thank you for Your attention!

Bartłomiej Ambrożkiewicz<sup>a</sup>, Zbigniew Czyż<sup>b</sup>

<sup>a</sup>Lublin University of Technology  
Nadbystrzycka 36, Lublin 23-200, Poland

<sup>b</sup>Polish Air Force University,  
Dywizjony 303 35, Dęblin 08-521, Poland

