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Experimental and theoretical analysis of a hybrid vibration energy harvester with integrated piezoelectric and electromagnetic interaction

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Schematic diagram

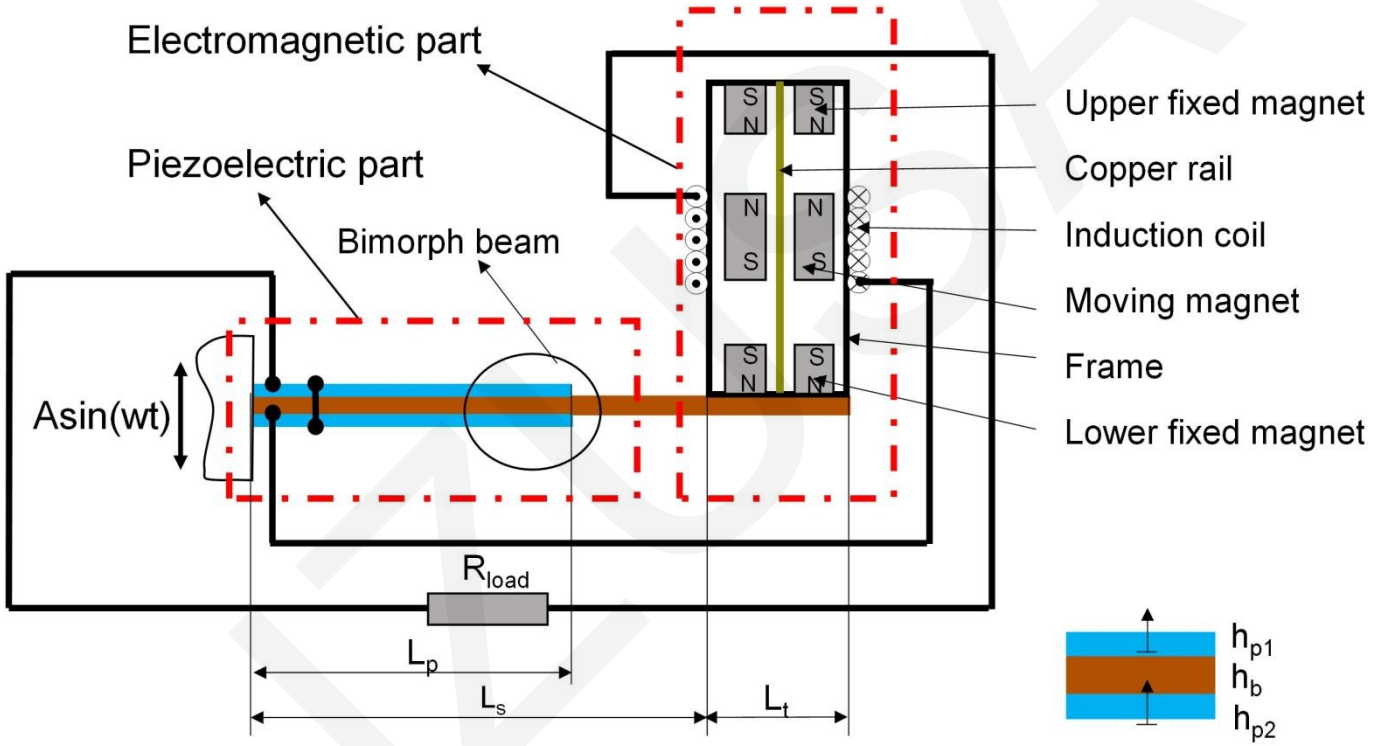

Fig.1. hybrid vibration energy harvester with integrated piezoelectric and electromagnetic interaction

Different connection topologies

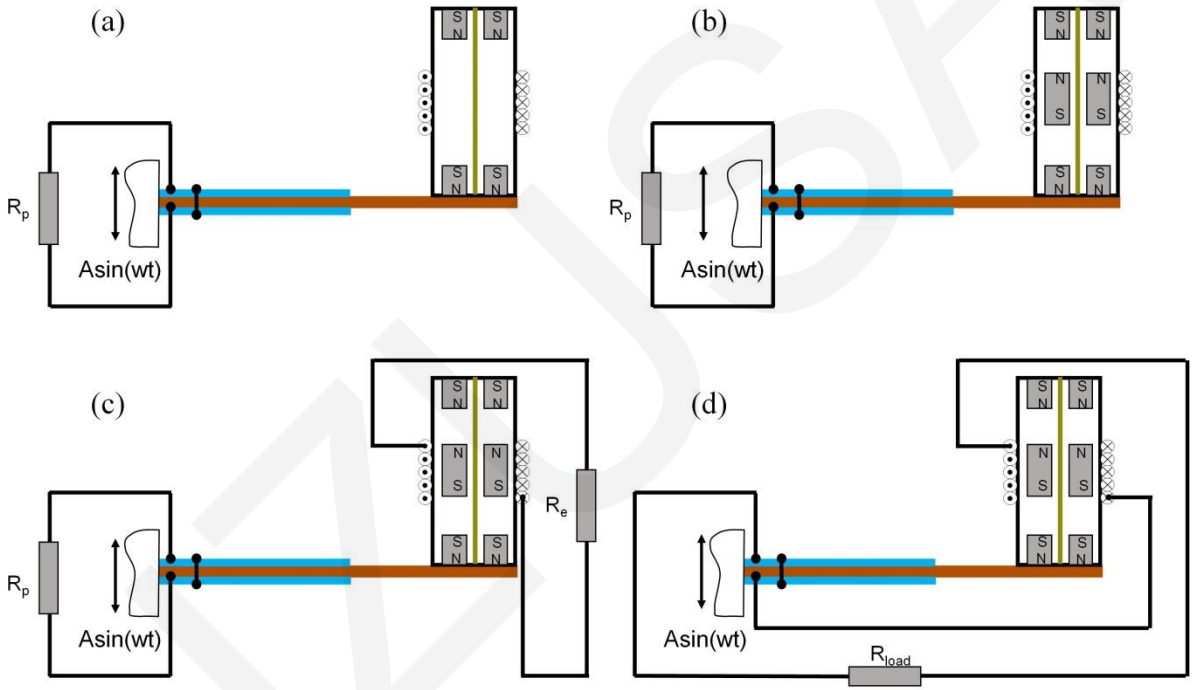

Fig. 2. (a) connection topology 1; (b) connection topology 2; (c) connection topology 3; (d) connection topology 4

test rig

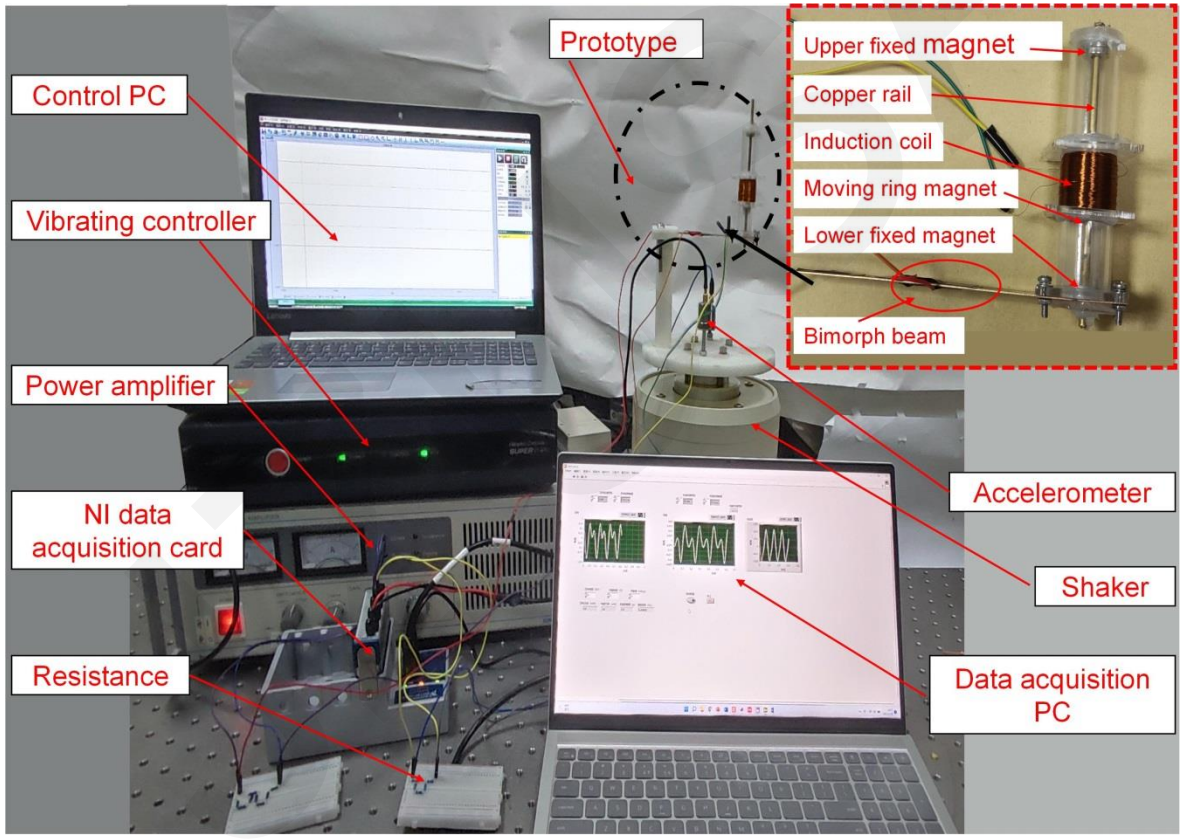

Fig.3. Schematic diagram of the studied HEHPE (PC: personal computer)

Comparisons of the models and the experiments

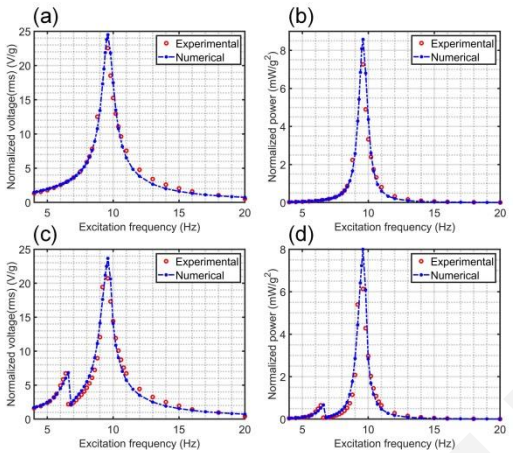

Fig.4. (a) and (b) for connection 1 and (c) and (d) for connection 2, respectively

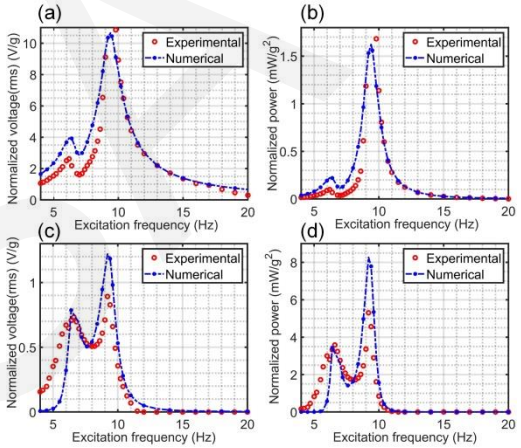

Fig.5. piezoelectric part ((a) and (b), respectively) and electromagnetic part ((c) and (d), respectively) for connection 3

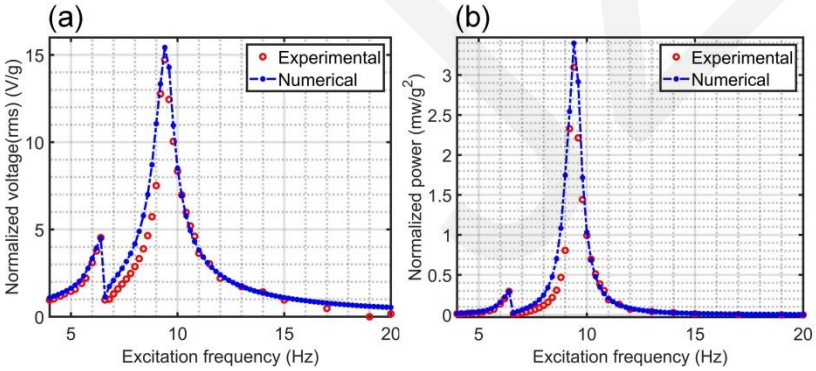

Fig.6. For connection topology 4

Modifications of the harvester

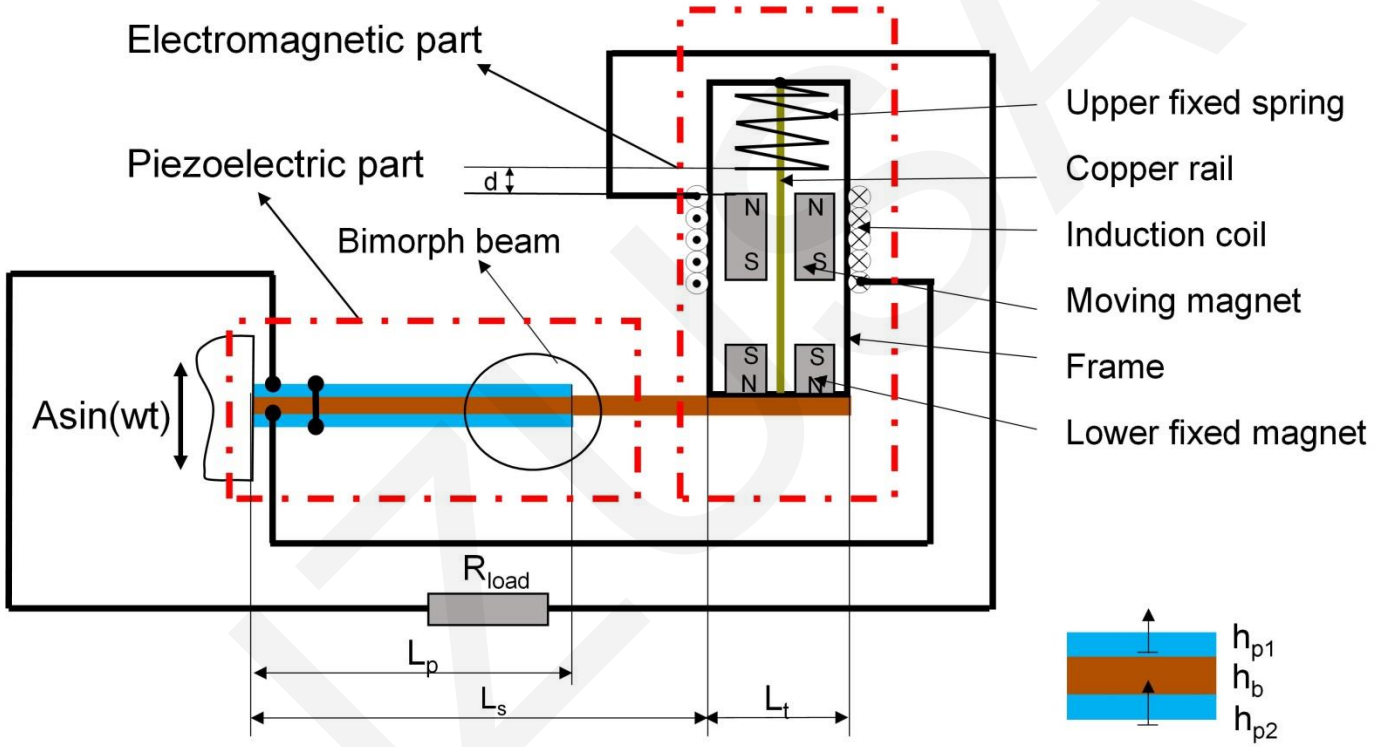

Fig.7. Diagram of the structure of the modified HEHPE with the upper fixed magnet replaced with a fixed spring

Output performance of the modified HEHPE

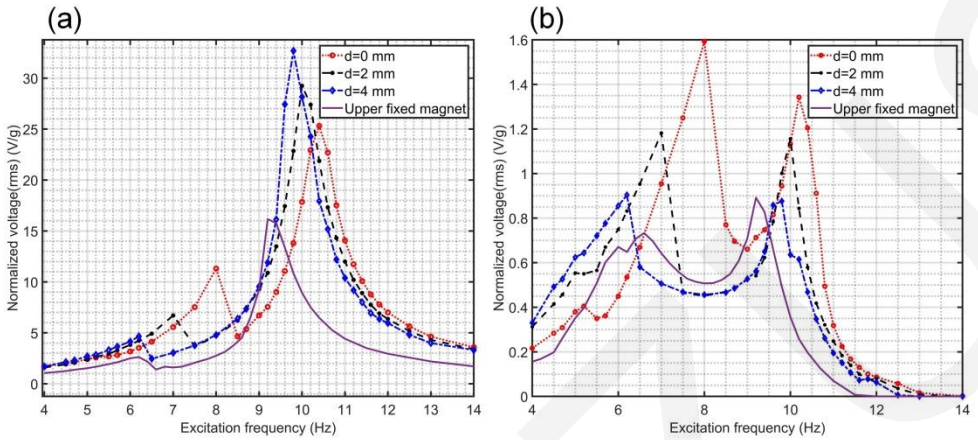

fig.8. connection topology 3: (a) RMS voltage of the piezoelectric part; (b) RMS voltage of the electromagnetic part

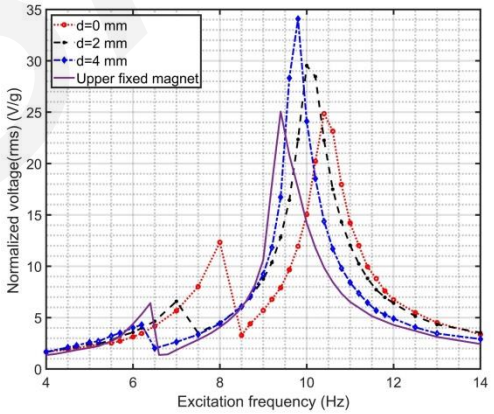

Fig.9. connection topology 4

Conclusion

- With regard to different connection topologies, the rms voltage and average power of the HEHPE were investigated and compared with numerical predictions based on a developed model. Good agreement was found.
- With regard to different connection topologies, the rms voltage and average power of the HEHPE were investigated and compared with numerical predictions based on a developed model. Good agreement was found.
- Also, the original HEHPE was modified by replacing the upper fixed magnet with an elastic spring. An obvious performance improvement was witnessed and considerable frequency tuning observed. Changing the distance d between the spring and the moving magnet was shown to greatly affect device behavior.