

Dataset: Improved tangential interpolation-based multi-input multi-output modal analysis of a full aircraft

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Version control (latest is current)	
V1	(16/11/2024) Initial release
V2	(17/11/2024) Typos correction in README.pdf Added sheet to <code>HAWK_modalParam.xlsx</code> with channels description

Foreword

Thank you for downloading the dataset linked to the article [Improved tangential interpolation-based multi-input multi-output modal analysis of a full aircraft](#). Please when using the data included in this dataset always cite [1-2]. This dataset is licensed under GPL v3.

Dataset

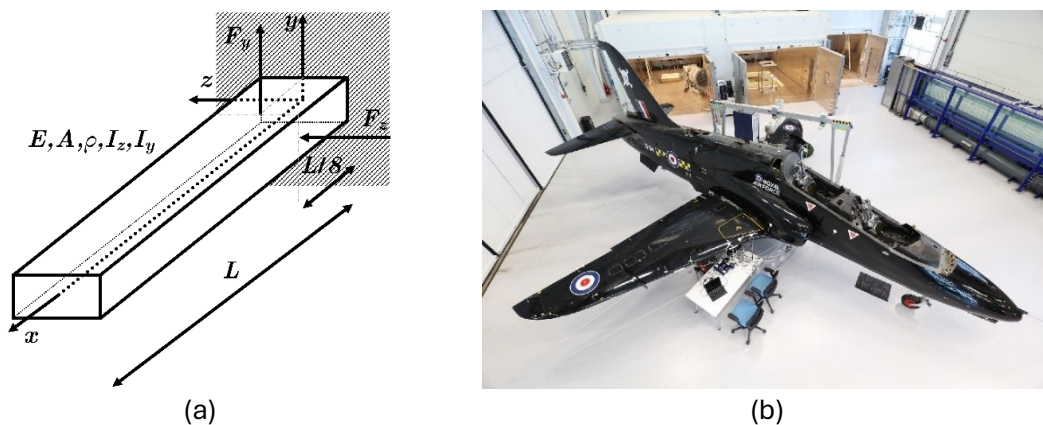


Figure 1 The numerical system is a hollow beam excited in the z and y direction with an impulse force (Figure 1a – Retrieved from [1]) and the experimental system is a decommissioned BAE Systems HAWK T1A (Figure 1b – Retrieved from [3]) instrumented with 85 accelerometers and 5 shakers.

The dataset included in this accompanying data refers to the paper in [1]. The dataset presents the results identified from the numerical (Figure 1a) and experimental (Figure 1b) systems identified in [1]. The following files and subfolders are included in the repository:

- **Mode shapes fig files:**
 - Folder containing the MATLAB `.fig` files of the mode shapes plots of the first six modes. `phi_n.fig` with $n=1-6$ (n is the mode number).
- **beam_data.mat**

This `.mat` file contains the data from the numerical system:

 - **err:** $3 \times 16 \times 4$ ($m \times n \times p$) matrix representing the error in percentage of the natural frequencies ($m=1$), damping ratio ($m=2$), and mode shapes ($m=3$ – the MAC value is shown) identified via N4SID ($p=1$), LSCE ($p=2$), LF ($p=3$), and iLF ($p=4$). n is the mode number, 1 to 16.
 - **freq:** the frequency bins vector (1×1000).
 - **FRF:** $16 \times 2 \times 1001 \times 5$ ($m \times n \times p \times q$) matrix. m is the output channel, such that at each node the vertical (y -direction) channel, precedes the horizontal (z -direction). n is the input channel, $n=1$ vertical input. p is the frequency bin. q is the scenario, such that $q=1$ is the baseline and $q=2-6$ the noised scenario in ordered by their level.
 - **fs:** is the sampling frequency.
 - **id:** 18×16 matrix representing the analytical modal results of the system organised as such: $m=1$ natural frequencies, $m=2$ damping ratios, $m=3-18$ modal displacement at each channel. p is the mode number.
 - **id_ilf_noise:** the raw data of the iLF identified modes for order $k = [32, 60]$. These are only provided for the noised scenarios. The cell index accesses the corresponding noise case result (1-5 – ascending order wrt noise level).
 - **id_stab:** $18 \times 16 \times 4$ matrix showing the modal parameters identified by N4SID ($p=1$), LSCE ($p=2$), LF ($p=3$), and iLF ($p=4$). m and n have the same meaning as per `id`.
 - **signal:** $2001 \times 18 \times 5$ matrix is the time series of the signals. Channels $n=1-2$ are the input and $n=3-18$ the output (vertical is always first – see `err`), p is defined as q is in FRF, and m is the time instant.
- **HAWK_modalParam.xlsx:**

Excel spreadsheet of the modal parameters identified from the BAE Systems Hawk T1A
- **lsce_fr.m:**

LSCE MATLAB implementation used in this work.
- **n4sid_fr.m:**

N4SID MATLAB implementation used in this work.

For any questions, problems or any other enquiry relating to this document or dataset please email the author at gdessena@ing.uc3m.es.

References

- [1] G. Dessena and M. Civera, “[Improved Tangential Interpolation-based Multi-input Multi-output Modal Analysis of a Full Aircraft](#)”, *European Journal of Mechanics - A/Solids*, vol. 109. Elsevier BV, p. 105495, Jan. 2025. doi: 10.1016/j.euromechsol.2024.105495. Available online at [<https://doi.org/10.1016/j.euromechsol.2024.105495>]

- [2] G. Dessena, “[Data supporting: Improved Tangential Interpolation-based Multi-input Multi-output Modal Analysis of a Full Aircraft](#)”. Universidad Carlos III de Madrid, Aug. 07, 2024. doi: 10.5281/zenodo.13254981. Available at [<https://zenodo.org/records/13254981>]
- [3] J. Wilson, M. D. Champneys, M. Tipuric, R. Mills, D. J. Wagg, and T. J. Rogers, “[Multiple-input, multiple-output modal testing of a Hawk T1A aircraft: A new full-scale dataset for structural health monitoring](#),” 2024, arXiv. doi: 10.48550/arXiv.2406.04943. Available at [<https://arxiv.org/abs/2406.04943>]