

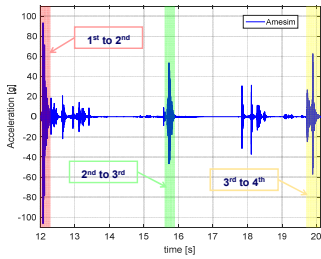
An integrated multi-modelling and experimental approach to NVH performance

Candidate:
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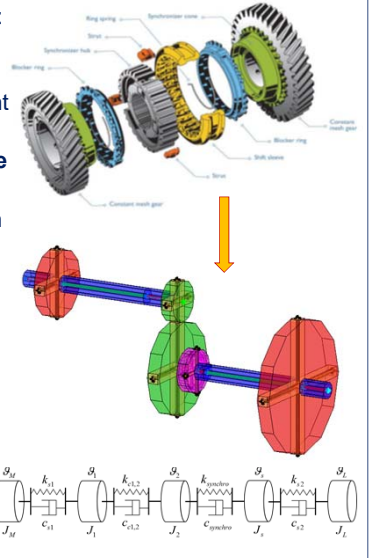
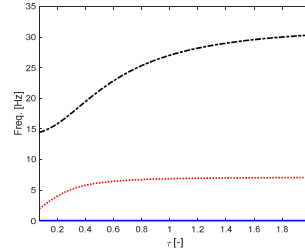
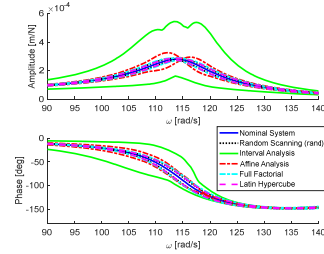


Tutors:
Prof. Elvio Bonisoli
Prof. Federico Millo

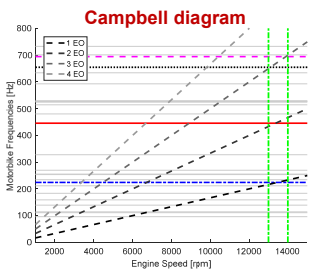
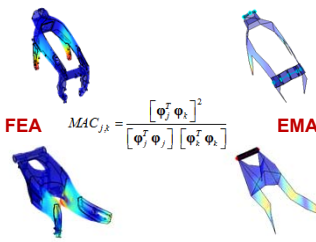
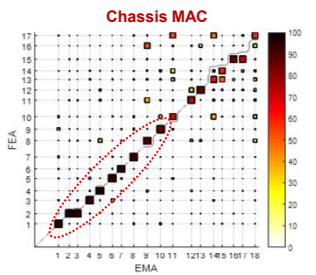
1. Uncertainty on synchroniser control



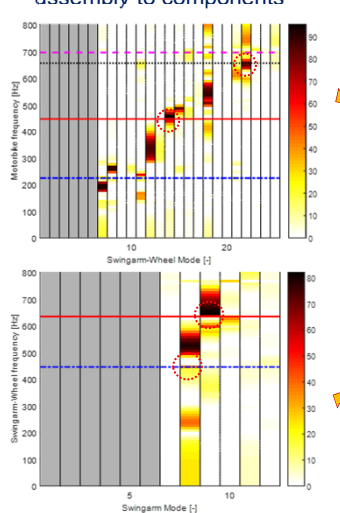
- Development of a methodology for the objective evaluation of **gear-shift induced vibrations** in a **DCT gearbox** through computation of gearbox housing acceleration, using a very detailed model of synchroniser
- Sensitivity analysis on model parameters for gear-shift noise assessment to reduce **axial and rotational impacts** during gear engagement
- Study of the effects of **uncertain parameters** on the **dynamic response** of a mechanical system using deterministic and stochastic approaches
- Development of a 5 DoFs rotational system, representing a transmission with a simplified synchroniser, to apply **uncertainty dynamics** concept on the design of a **control strategy** for the **synchronisation phase**



2. Multibody system analysis



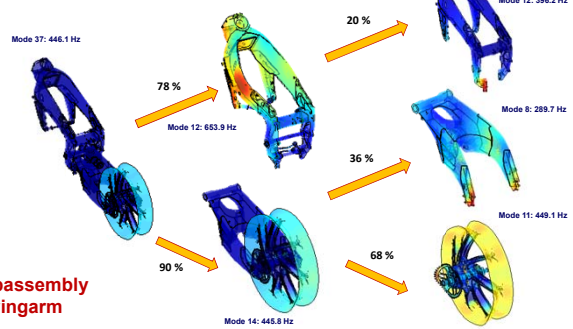
- Development of a **modal based method** for the **re-design** of flexible multibody components to achieve **better dynamic performance** under operative working condition, identifying the most influenced components in **critical frequency range** of multibody system
- The method is applied to the **engine excitation** on a motorbike frame
- Experimental and numerical modal analysis on components, subsystems and assembly and **EMA – FEA correlation** for CAD model tuning
- The method is used to understand the contribution of each component mode on the level-up subsystems, to detect structurally critical components and it is a novel approach for **mode shape tracing** from assembly to components



Motorbike vs rear subassembly

$$\tilde{\Psi}_{OD,k}(\omega) = \sum_{r=1}^r \frac{\Phi_r \Phi_{k,r}}{\omega_r^2 + 2i\zeta_r \omega_r \omega - \omega^2}$$

2nd global mode of motorbike



Rear subassembly vs swingarm



3. Publications

- Cirmele V., Dimauro L., Repetto M., Bonisoli E., "Multi-objective optimisation of a magnetic gear for powertrain applications", *International Journal of Applied Electromagnetics and Mechanics*, Vol. 60 (S1), ISSN: 1383-5416, DOI: 10.3233/JAE-191103, pp. 25-34.
- Bonisoli E., Lisitano D., Dimauro L., Peroni L., "A proposal of dynamic behaviour design based on mode shape tracing: numerical application to a motorbike frame", *Dynamic Substructures*, Vol. 4, *Proceedings of the 37th IMAC*, A Conference and Exposition on Structural Dynamics, Conference Proceedings of the Society for Experimental Mechanics Series, 186 pp., Ch. 14, 2020, Springer, ISBN: 978-3-030-12183-9, DOI: 10.1007/978-3-030-12184-6_14, pp. 149-158.
- Galvagno E., Dimauro L., Mari G., Velardocchia M., Vella A.D., "Dual Clutch Transmission Vibrations during Gear Shift: A Simulation-Based Approach for Clunking Noise Assessment", *SAE Technical Paper*, 2019-01-1553, 2019, DOI: 10.4271/2019-01-1553, pp. 1-12.
- Bonisoli E., Lisitano D., Dimauro L., "Experimental and numerical mode shape tracing from components to whole motorbike chassis", *International Conference on Noise and Vibration Engineering, ISMA*, 2018, Leuven, Belgium, September 17-19, pp. 3597-3604.