

# IDENTIFICATION OF THE ELASTIC PROPERTIES OF PARTICLE BOARDS AND STOCHASTIC SIMULATION OF WOOD-BASED FURNITURE

Z. Chen<sup>\*1,2</sup>, F. Pled<sup>1</sup>, L. Chevalier<sup>1</sup> and E. Launay<sup>2</sup>

<sup>1</sup> Université Paris-Est, Laboratoire Modélisation et Simulation Multi Echelle, MSME  
UMR 8208 CNRS, 5 bd Descartes, 77454 Marne-la-Vallée, France,

{zhou.chen,florent.pled,luc.chevalier}@univ-paris-est.fr, <http://www.msme.u-pem.fr/>

<sup>2</sup> Institut technologique Forêt Cellulose Bois-construction Ameublement (FCBA), 10 rue  
Galilée, 77420 Champs-sur-Marne, France, eric.launay@fcba.fr, <http://www.fcba.fr/>

**Keywords:** *Particle boards, Characterization of elastic properties, Digital image correlation, Finite element plate model, Probabilistic modeling, Maximum Entropy principle*

In furniture industry, the numerical simulation allows the design and optimization of wood-based structures, thus avoiding expensive experimental campaigns. Most of wood-based furniture present some particular features in terms of material properties and geometries. On the one hand, the properties of timber materials (such as particule boards) are strongly heterogeneous and anisotropic. On the other hand, the furniture are often made of simply-shaped elements and then can be represented by an assembly of plates and/or beams. The present work deals with those specific features and presents the identification of the elastic properties of particle boards from digital image correlation (DIC) [1] as well as the simulation of the mechanical behavior of furniture.

First, three-point bending tests based on Timoshenko's beam theory are performed on different samples cut from a prototype desk for the identification of the material properties using DIC techniques. Secondly, a probabilistic model for the uncertain material parameters is constructed by using the Maximum Entropy (MaxEnt) principle [2] combined with a Markov Chain Monte-Carlo (MCMC) method based on Metropolis-Hastings algorithm for generating realizations of the underlying random variables. Thirdly, numerical virtual tests are performed to propagate the uncertainties in the material properties through the model and assess the impact of such variabilities on the response of the structure. Lastly, several real tests were previously conducted on the desk in order to validate the proposed numerical approach. Quite good agreement is observed between the numerical computations and the experimental measurements.

## REFERENCES

- [1] L. Chevalier, S. Calloch, F. Hild and Y. Marco, Digital image correlation used to analyze the multiaxial behavior of rubber-like materials. *European Journal of Mechanics-A/Solids*. Vol. **20**(2), pp. 169–187, 2001.
- [2] C. Soize, *Uncertainty Quantification: An Accelerated Course with Advanced Applications in Computational Engineering*. Springer, Vol. **47**, 2017.