ANALYSES AND VALIDATION OF CUTTING FORCES PREDICTION MODELS IN WOOD MACHINING

Marija Djurković, Gradimir Danon

ABSTRACT

A lot of research has been done related to the influence of different machining factors on the wood machining process. Methodologically, the factors are divided into three main groups that affect cutting mechanics: factors associated with material properties, factors that are dependent on the cutting tools, and factors attributed to the cutting process itself. A better understanding of machining factors could be the foundation for predicting the behavior of the material in the machining process. Also, it may consequently contribute to a more efficient and economical machining outcome and above all, the better quality of the machined surface. One of the basic parameters of cutting mechanics is cutting forces. There are various models in literature for determining the dependence of values of cutting forces on the selected impact factors. Different cutting force models are analyzed and compared in this paper. The results performed in the peripheral milling parallel with wood grains of oak wood (Quercus robur) were used for testing the models. The analysis of these models indicated that there is no match between the calculated and the experimental results, but there is a similarity in the form of the curve. Changes in the measured values are accompanied by corresponding changes in the calculated values, which indicates that these models can find application in real cutting conditions.

REFERENCES

Axelsson, B., Lundberg, Å., and Grönlund, J. (1993): Studies of the main cutting force at and near a cutting edge, Eur. J. Wood Wood Prod. 51(1): 43-48.

Curti, R., Marcon, B., Denaud, L, Togni · M., Furferi · R., Goli G. (2021): Generalized cutting force model for peripheral milling of wood, based on the effect of density, uncut chip cross section, grain orientation and tool helix angle. Eur. J. Wood Prod. 79, 667-678.

Đurković, M., and Danon, G. (2017): Comparison of Measured and Calculated Values of Cutting Forces in Oak Wood Peripheral Milling, *Wood Research*, 62(2), 293-306.

Eyma,F., Méausoone, P, Martin, P. (2004): Study of the properties of thirteen tropical wood species to improve the prediction of cutting forces in mode B. Annals of Forest Science, Ann. 61: 55–64 55.

Goglia, V. (1994): Tools and machines for wood processing I. University of Zagreb – Faculty of Forestry, Zagreb, 40-78 (In Croatian).

Krenke K, Frybort S, Müller, U. (2017b): Cutting force analysis of a linear cutting process of spruce. Wood Mater Sci Eng 13(5):279-285.

Krenke, T., Frybort, S., Müller, U. (2017a): Determining cutting force parameters by applying a system function. Mach Sci Technol 21(3):436-451.

Kršljak, B. (2013): Tools and machines for wood processing I. University of Belgrade, Faculty of Forestry, Belgrade, 5-36 (In Serbian).

Mandić M., Porankiewicz B., Danon G. (2015): An Attempt at Modelling of Cutting Forces in Oak Peripheral Milling, *BioResources*, 10(3), 5489-5502.

Mandić, M., Mladenović, G., Tanović, Lj. and Danon, G. (2014): The predictive model for the cutting force in peripheral milling of oak wood, in: *Proceedings of the 12th International Conference on Maintenance and Production Engineering KODIP*, Budva, Montenegro, pp. 231-238.

Naylor, A., Hackney, P., Perera, N., Clahr, E. (2012): Mechanical cutting force model. A predictive model for the cutting force in wood machining developed using mechanical properties.BioResources 7 (3): 2833-2894.

Orlicz, T. (1982): Obróbkadrewnanarzędziamitnącymi, (Machining of wood with use of cutting tools), in: *Study book SGGW-AR*, Warsaw.

Orlowski, K.A., Ochrymiuk, T., Hlaskova, L., Chuchala, D.,·Kopecky, Z. (2020): Revisiting the estimation of cutting power with different energetic methods while sawing soft and hard woods on the circular sawing machine: a Central European case. Wood SciTechnol 54, 457- 477.

Porankiewicz, B., Axelsson, B., Grönlund, A., andMarklund, B. (2011): Main and normal cutting forces by machining wood of *Pinussylvestris*, *BioResources* 7(3), 2883-2894.

Porankiewicz, B., Wieczorek, D., Djurkovic, M., Idzikowski, I., and Węgrzyne, Z. (2021): Modelling cutting forces using the moduli of elasticity in oak peripheral milling, BioResources 16(1), 1424-1437.

Zubčević, R. (1988): Wood processing machines, Part 1, the theory of cutting.Univerzitet u Sarajevu – Mašinski fakultet, Sarajevo, 4-71 (In Bosnian).