## ABSTRAK

Gaya potong pada proses bubut dapat diukur menggunakan dinamometer dan dapat digunakan untuk mengevaluasi kualitas proses pemotongan. Dinamometer yang ada di pasaran saat ini diproduksi oleh Kistler Instruments (Pte) Ltd dan dijual dengan harga yang cukup mahal. Oleh karena itu, penelitian ini mendesain serta menganalisis statik dan dinamik tranduser berbentuk *full octagonal shaped ring* untuk mengukur gaya potong pada proses bubut tegak (*orthogonal cutting*). Desain tranduser tersebut dianalisis secara statik menggunakan metode *Finite Element Method* (*FEM*) dan dinamik menggunakan metode *Experimental Modal Analysis* (*EMA*) untuk mengetahui kekuatan strukturnya. Hasil analisis statik kekuatan struktur tranduser akan mampu menahan beban statik sebesar 224 hingga 388 N karena tegangan tranduser tidak melampaui *yield strength* material yaitu 233 MPa. Sedangkan simulasi analisis dinamik struktur tranduser menggunakan EMA menunjukkan bahwa frekuensi pribadi (*natural frequency*) sebesar 3851 Hz, rasio redaman (*damping ratio*) sebesar 1,04%, konstanta kekakuan (*stiffness*) 18,5 x $10^6$ N/m, modal massa sebesar 32 g, dan koefisien redaman yaitu 16 N.s/m. Selain itu, juga dilakukan eksperimen analisis dinamik dan didapatkan hasil frekuensi pribadi (*natural frequency*) sebesar 3856 Hz, rasio redaman (*damping ratio*) sebesar 2,6%, konstanta kekakuan (*stiffness*) 13,4 x $10^6$ N/m, modal massa sebesar 23 g, dan koefisien redaman yaitu 29,4 N.s/m. Dari hasil analisis dinamik tersebut desain tranduser untuk dinamometer *low-cost* ini akan aman dan *reliable* ketika digunakan pada proses bubut dengan kecepatan putaran *spindle* mencapai 20 Krpm.



**Kata kunci:** *dinamometer, experimental modal analysis (EMA), finite element analysis (FEM), proses bubut, pemotongan orthogonal.*

***ABSTRACT***

*Cutting forces in the lathe process can be measured using a dynamometer and can be used to evaluate the quality of the cutting process. Dynamometers on the market today are manufactured by Kistler Instruments (Pte) Ltd and are sold at quite expensive prices. Therefore, this study designs and analyzes the static and dynamic tranducers in the form of a full octagonal shaped ring to measure cutting forces in the orthogonal cutting process. The tranducer design was analyzed statically using the Finite Element Method (FEM) and dynamically using the Experimental Modal Analysis (EMA) method to determine its structural strength. The results of the static analysis of the strength of the tranducer structure will be able to withstand static loads of 224 to 388 N because the tranducer stress does not exceed the yield strength of the material which is 233 MPa. While the simulation of the dynamic analysis of the tranducer structure using EMA shows that the natural frequency is 3851 Hz, the damping ratio is 1.04%, the stiffness constant is 18.5 x 106 N/m, the modal mass is 32 g, and the damping coefficient is 16 N.s/m. In addition, dynamic analysis experiments were also carried out and the results obtained personal frequency (natural frequency) of 3856 Hz, damping ratio of 2.6%, stiffness constant (stiffness) 13.4 x 106 N/m, mass capital of 23 g, and damping coefficient of 29.4 N.s/m. From the results of the dynamic analysis, the tranducer design for this low-cost dynamometer will be safe and reliable when used in the lathe process with spindle rotation speeds reaching 20 Krpm..*

***Keywords:*** *dynamometer, experimental modal anaylis (EMA)*, *finite element analysis* (*FEM)*, *orthogonal cutting, turning process.*