PRECISION CUTTING IN CNC TURNING MACHINES

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Abstract

Precision cutting, considering the time, cost and flexibility of the production, has been one of the major goals in manufacturing. Especially using new technological tools such as linear motors, laser and piezoelectric actuators in cutting operations to increase the accuracy of the workpieces produced, is becoming more popular day by day.

In this thesis, a new precision cutting system is developed to decrease the basic workpiece errors (straightness, roundness, diameter error, etc.) for commercial CNC lathes in a cheaper way. In order to characterise the CNC lathe, a laser displacement sensor is used. A mechanical design with piezo stack actuator and tool tip, i.e. piezo based cutting device (PBCD), is inserted on the turret of CNC lathe to give both static and dynamic finish cutting operation of PBCD. FEA (Finite Element Analysis) tool is used at the design stage of PBCD. The controller of PBCD is PID (Proportional Integrate Derivative) control that is running in the dSPACE software. In dynamic operation of PBCD, instantaneous angular position of CNC lathe spindle is specified by means of the rotary encoder. And it is used in the control loop for active elimination of roundness errors of cylindrical workpieces during cutting operation. The results after assessment of the measurements of cylindrical workpieces are encouraging. In static operation of PBCD, the finish cutting decreases the roundness error at an amount of at least 30% with respect to the operation without control of PBCD.

In most CNC turning machines, if cutting conditions such as cutting speed and feed, tool geometry and vibration are not changed, the workpiece geometric errors are mostly repeatable. So it may not be needed to measure the geometric errors of the same workpiece produced at the same cutting conditions after each cutting operation. Especially in mass production, all cutting conditions and workpiece produced are same. So, the PBCD would be very useful tool in mass production regarding the repeatability of workpiece geometric errors.

üretim sistemlerindeki temel hedeflerden birini oluþturmaktadýr. Özellikle üretilen iþparçalarýnýn doðruluðunu artýrmak için yapýlan kesme iþlemleri sýrasýnda kullanýlan lineer motor, lazer ve piezoelektrik a

Bu tezde, piyasadaki CNC torna tezgahlarý üzerinde üretilen iþparçalarýnýn hatalarýnýn

kesme sistemi geliþtirilmiþtir. CNC torna tezgahýnýn karekterizasyonu için lazer uzaklýk ölçüm sensörü kullanýldý. Piezostak akçuatör, kesme kalem ucu ve mekanik tasarýmdan oluþan piezo temelli kesme aleti (PBCD) son kesme pasosunu hem statik hemde dinamik almak için, CNC torna tezgahý tareti üzerine monte edilmiþtir. PBCD nin tasarým aþamasýnda sonlu elemanlar analizi (FEA) kullanýlmýþtýr. PBCD nin kontrolörü dSPACE yazýlýmýnda koþulan PID (Proportional Integrate Derivative)
torna eksen motorunun enkoderi silindirik iþparçalarýnýn yuvarlaklýk hatalarýnýn aktif eliminasyonu için kontrol döngüsü içine alýnmýþtýr. Silindirik iþparçalarýnýn makine dýþý muþtur. PBCD ile yapýlan statik son kesme pasosu yuvarlaklýk hatasýndaki azalmanýn en az 30 % oldugunu göstermektedir.

Bir çok CNC torna makinalarýnda, kesme hýzý ve pasosu, kalem geometrisi ve titreþimi

Dolayýsýyla ayný parçalarýn ayný durumlarda kesimi ile oluþan parça geometrik hatalarýný, her kesim iºleminden sonra ölçmeye gerek kalmayabilir. Özellikle seri üretimde, bütün kesme r. Dolayýsýyla, PBCD seri üretim için çok yararlý bir araç olabilir.

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