CO-EFFICIENT FOR FINITE ELEMENT CALCULATION FOR MATERIAL SURFACE ALUMINIUM

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Abstract:
The friction condition is an essential element in regulating the metal forming compressing cycle. The FCMs are commonly used in calculating the stress factors between the workpiece and die. In the standard FEA, the friction condition is defined by the coefficient of friction (μ) while the FCM is used to describe constant hear (m) friction, which is of great importance for the interface workpiece and tooling operations; a precise description of the friction is necessary to analyze and design new workpieces and tools. This paper proposes a method of determining and evaluating the average frocking factor (COF) by Dyna form for aluminum alloy using the Finite Element Method (FEM). The results suggest that this methodology is realistic. The baseline FEA model, several formulas are developed, through the statistical analysis and a simulation results of the Ring Compression Test, between deformation parameters, material mechanical properties and μ factors. Based on these formulas is a procedure for picking and using the time-sequence μ factor to for the relevant content.

1.0 Introduction

The friction coefficient is one of the metrics defining the resistance of two moving objects to relative motion. Historically, Leonardo Da Vinci (1508) proved that the friction force was commensurate with the load. Amonton (1700) made the relationship that shear stress is commensurate with normal frictional stress. The first attempts at explaning friction were based on surface asperity interactions. Nevertheless, it is now widely agreed that, while mechanical interactions play a part, the high friction coefficient seen in clean environments can only be explained by obedience between touching asperities . Recently, it has been a priority to improve awareness on friction in sheet-forming operations. Many methods have been researched for calculating friction coefficients (COF), and bending under tension test (BUT), probably the most common approach used. A stripe is bent and slid in this test through a pin with a certain radius (R), under which a deep drawing will mimic the same conditions of the die radius. This research was used by Lee et al. to analyze the relation of ruggedness of the earth, gravitational film and COF. The COF variability in the speed and temperature of the blank was explored by the pin-on - disk test.

Surface treatment of aluminium alloys:

Inorganic layers are applied to protect atmospheric corrosion metals. Until adding coats of pigment, oxidation and phosphation are done to obtain intermediate concentrations. For decorative ends of materials, carcasses and control systems, oxide and chromate films are used. Other metallic surface characteristics, including hardness, wear resistance, electro-insulating properties etc. are enhanced by coating them with oxides and phosphates. Anodizing, rough anodizing, chromating and light (chemical polishing) are the most common surface preparation methods for aluminium.

2.0 Literature review:

Kogut, L., Etsion [1] The aluminum coating is normally coated by an aluminum oxide layer of less than 1-2µm in contact with an atmosphere. This coating doesn't protect the metal from corrosion due to its low thickness, high porosity, and poor mechanical strength. The most popular type of superficial oxidation is the anodizing for protective and decorative applications, and is carried out through the anodizing process.

Wu, A.Z., Shi, X. [2] The deformations are linearly related to external stresses with the theory of elastic behavior. Two mechanical properties of the material are included in the estimation of flat stress. The elasticity modulus (E) which is related to the material's ability to bend after external efforts are exerted and the Poisson coefficient (È) which takes care of the material's ability to decrease its volume from external impact.

Li, L., Etsion, I., Talke [3] Finite element analyzes (FEA) are a computational approach that can not be represented very well in the study of structural components. The advancement of calculation methods' efficacy and their practical application are one of the highest development goals in this field, given an ever growing computing capacity.

3.0 calculation for material surface aluminium

Aluminum is one of the lightest sheet metals in the aeronautical industry and are very requested to meet environmental safety and energy conservation requirements. The Al alloys have drawn increasing global interest in large-scale aerospace applications in recent years, primarily due to the high fuel costs and modern civilian and military airplane technologies. Alloys are a global market. Lithium is the lightest metallic element, it is the only metal that decreases density allegedly to aluminum and improves elastic module. It could reduce the density by 1 percent of Li and almost increase by 6 percent in elastic module

Single Surfaces:

Thermoelastic stress calculations for finite elements under static conditions (i.e. failure to generate dislocation and the crystal growth rate) show that the highest stresses (which occur within one sheet of interface width) rise with (µw). If the shear stress µe=(sijsij/2)1/2 is equal to no more than the silicone yield stress in shear ȚY (almost 3 mpa in Tm), then the dislocation-free size restriction is required for the single EFG point.

$$\tau_y \geq 7.5 \times 10^{-2} \alpha E G_0 w$$

FEM in the whole state of the ring. In order to model continuous frictions between rough surfaces they integrate finite element effects into statistical representation for surface ruggedness. The normal load Fn and maximum friction force, (Ft)max, can be expressed using two of the same governing equations in the G W model:

$$F_n = \eta A_n \int_{d^*}^{\infty} \overline{F}(\omega^*) \phi^*(z^*) dz^*$$

$$(F_t)_{max} = \eta A_n \int_{d^*}^{\infty} (\overline{F}_t)_{max} (\omega^*) \phi^*(z^*) dz^*$$

By solving Eq. and finding a best fit curve to the results, the dimensionless static friction (Ft) ∗ max is given by

$$(F_t)^*_{max} = \left(0.26 + \frac{0.43}{\psi}\right) (F_n^*)^{(0.0095\psi + 0.91)}$$

Hence, the static friction coefficient is given by

$$\mu_s = \frac{(F_t)^*_{max}}{F_n^*} = \left(0.26 + \frac{0.43}{\psi}\right) (F_n^*)^{(0.0095\psi - 0.09)}$$

where (Ft) ∗ max is the dimensionless tangential load and given by:

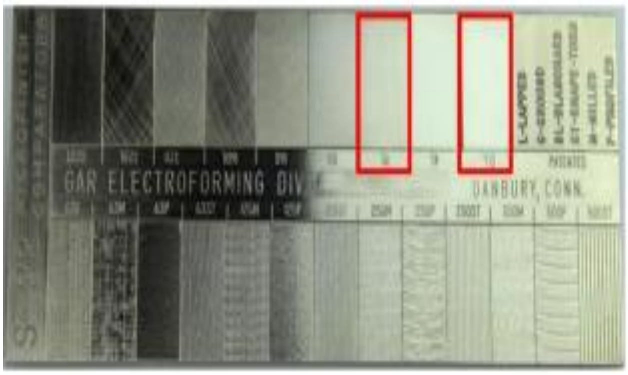


Figure: micro-finish surface finish scale

Surface conditions applied

In the profound drawing test, the following technique was used to achieve specific COFs between instruments and surfaces. Surface rugosity variation on die and blank-holder was caused in addition to four lubricants by the application of sandpaper with a particular grit. Surface finishing and lubricants were the special parameters, and all other parameters were similar.

The grain of sandpaper was 220, 400 and 1200. The methodology of application involved the adaptation of the matrices in a rotor with a steady speed of rotation ("chuck"). (Application method) In a single step and slowly enough, sandpaper applications were produced from the inside of the dies to make visible changes in the finish texture. The sandpaper was used from the largest to the smallest gravel to remove the previous surface finish, and if the 1200 was necessary the 220 and 400 sandpapers were sequentially applied . For this finish, after the application of each finishing sandpaper according to ISO standard, the average (Ra) and the maximum (Rmax) ruggedness of the surfaces were evaluated. Results for average 5 measurements are shown in Table 3.1 in µm. The adopted cutting parameter was 0.8 mm

Table: surface Roughness measures for each finish.

SANDPAPER	1200		400		220	
ROUGHNESS	R_A	R_{MAX}	R_A	R_{MAX}	R_A	R_{MAX}
Upper Die	0,20	2,36	0,32	2,98	0,32	2,56
Lower Die	0,30	2,38	0,20	2,18	0,27	2,64

The measured rughness in all applied finishes had very similar values can be observed. This is consistent with the literature, since Ra values between 0.4 and 0.2μm range from standard machining to polishing.

The punch measuring roughness's Ra and Rmax were respectively 0.11 and 1.46 μm, and no sandpaper was added, i.e. during all measurements these values remained unchanged. The result was that the punch just touches the material in the middle of the material with the structure used, where the sheet is practically deformed, and the slip between the surfaces is almost zero.

Lubricants are mineral-based oils widely used in sheet metal shaping industries. Lub F, lub L, lob O, and lub S were identified as the lubricants. The grease and a 0.09 mm hard Teflon layer were tested with two other lubricants. The state without lubricant (dry) was also checked and 1200 sandpaper were applied to the surface finish.

4.0 Analytical calculation of the maximum drawing force

There are many calculations used in the deep drawing method to determine the effective drawing power. These equations generally give limited information on the process or the material used because they apply to simple geometries or because they simplify several procedures that make the calculation more uncertain. Some examples include the equations used in a conventional stamping to calculate the maximum force. They are used for the calculation of the press intensity required for drawing a piece. Siebel and Panknin developed an analysis model on the basis of the basic plasticity theory.

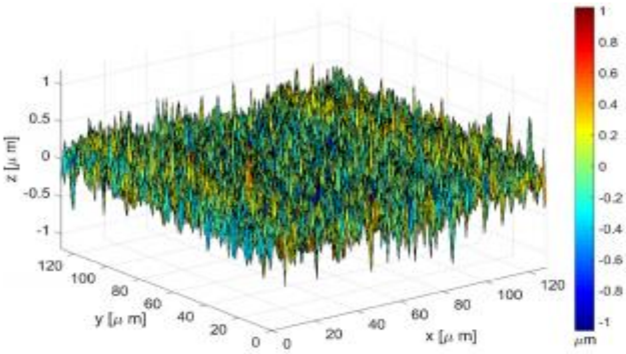


Figure: Three-dimensional plot of the surface1

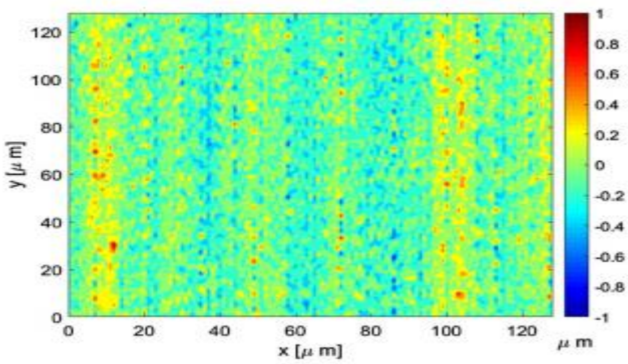


Figure: Topographical contour plot of the surface2

Surface 2 is our first consideration. The roughness of the base is 0.204 μm. In figures respectively, the three-dimensional structure and contour are illustrated. Many. Strange. The surface height is the data from a profilometer, and the height of asperity is measured using the concept of asperity, the superficial points greater than the adjacent points ..

A finite element is used in contrast to the multi-scale model (description in the following section) with the rough surface touch model, which has normal and tangential loading. In the figure you will see the FEM model and its limits

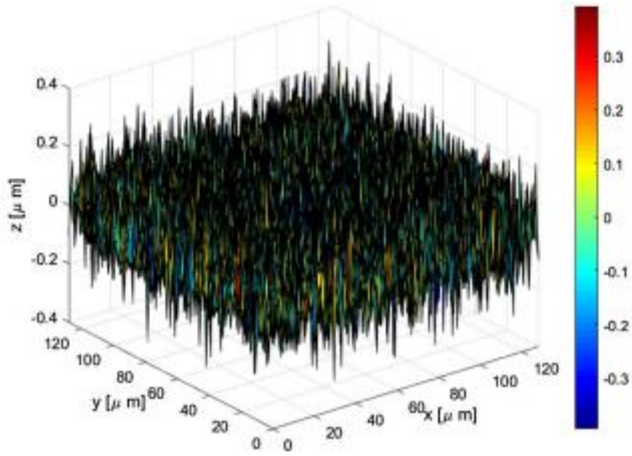
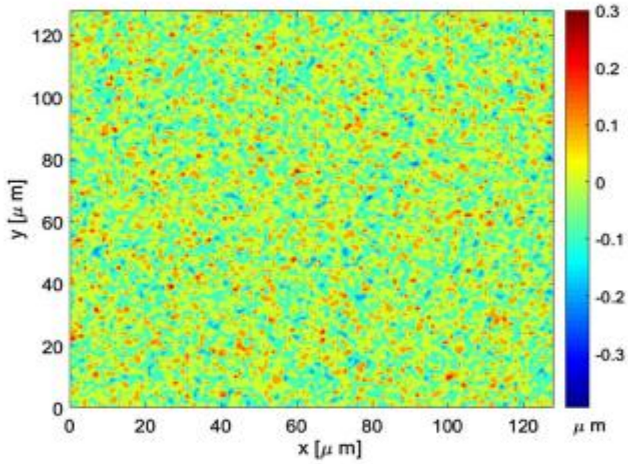
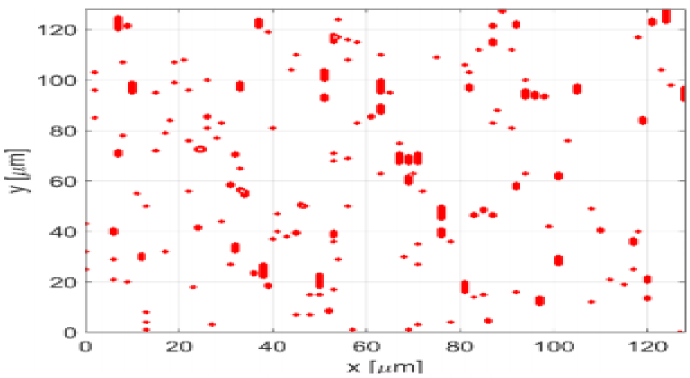


Figure: Three-dimensional plot of aluminium surface1

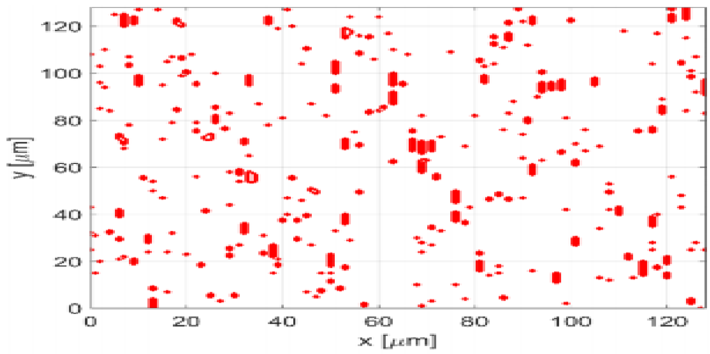


Figure; Topographical contour plot of aluminium surface 2



(a) $F_n/(A_n S_y) = 0.06$

Contact area under dimensionless normal loads for surface1



(b) $F_n/(A_n S_y) = 0.12$

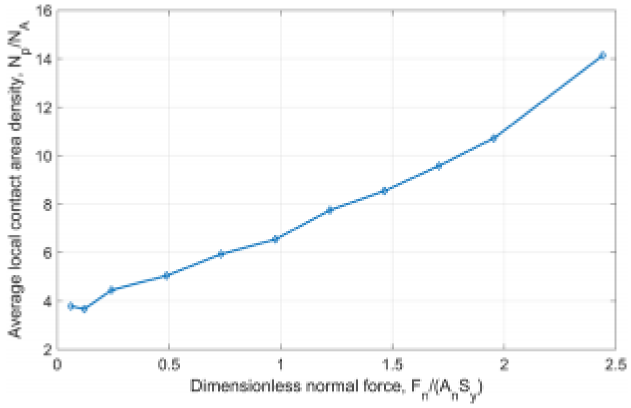


Figure: Average local contact area density versus dimensionless normal force for surface 2

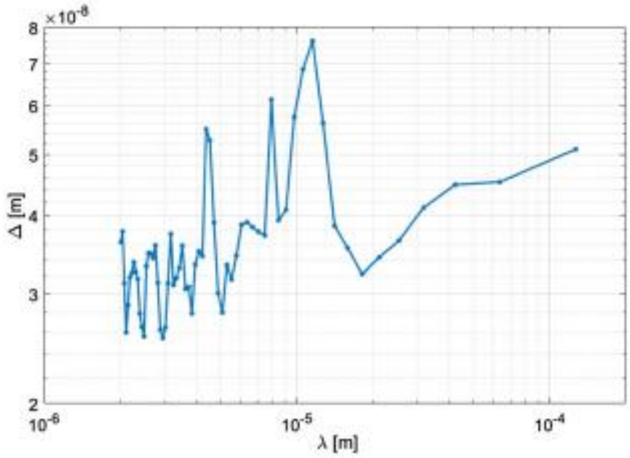


Figure: Resulting amplitude versus wavelength for the aluminium surface

Conclusion:

In the present study, an iterative, multi-scale model of friction models for modeling friction between rough aluminum surfaces using the rough surface reproduction of a series from Fourier is presented The proposed model has the same tendency as the theoretical models and the FEM results. The model proposed predicts lower static coefficients of friction than the results of FEM, while the predictions remain close to the theory models under high normal loads. The diffrence between the suggested model and the FEM results in static friction coefficients decreases with an increased normal pressure, where FEM is more accurate. The effect of the normal load on the coefficient of static friction was then evaluated. Surface1, surface2 and surface Al in the FE model have been utilized in this step. The results for FEM show that the static friction coefficient with burden is decreasing, while the current models of friction and predictive models forecast values of less variance. Again, the multi-scale model has minimal expectations, and the FEM models have substantial errors at low loads but at higher loads are more reliable. The FEM model and the multi-scale model are best suited for higher loads.

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