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CUTTING TOOLS DURABILITY AS A SIMULATION PARAMETER IN DISCRETE MATERIAL FLOW MANAGEMENT

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Abstract: *The new perspective used for the present paper regarding the tool's durability is its consideration as a simulation parameter which relates flow simulation and process simulation based on dynamic modern systems. For this kind of systems the increasing of costs for errors correction will also cause an increasing of the value for detecting and correcting the possible problems. In fabrication architecture optimization, the studies made up to present were focused on flow concentrator identification for a flexible system and eliminating the concentrator by modifying the number of work points in order to equilibrate the flow. The innovation consists in regulation of the flow based on durability data obtained from process simulation.*
Key words: *simulation, DEFORM, process, architecture*

1. INTRODUCTION

We define a concentrated fabrication system as a working point that is served by stocking systems, transfer and transport what ensures its autonomy functioning, without the interfering of the human operator (Cotet & Dragoi, 2003). DEFORM is a simulation system for technological processes based on Finite Elements Method (FEM), designed to analyze different formation and thermal treatment processes and for other associated processes from industry. Due to computer aided simulations for fabrication processes, this advanced program becomes a primordial instrument for designers and engineers having the following advantages: it reduces the costs with experimental assays and processing and processes redesign; it improves tools and matrix's design in the purpose of lowering the production costs; it reduces the necessary time for lunching a new product on the market (Bley & Wuttke, 1999; Nau et al., 1993).

Compared to other software based on finite elements method, DEFORM is designed for deformation modeling. The friendly interface allows to easily introducing the entry data and the analyzing parameters; in this way the user can spend more time modeling instead of learning a new program.

An important component is the existence of an optimized re-digitization system completely automated and adjusted for a large scale of deformation problems.

With DEFORM it is also possible modelling thermal treatment processes, like normalization, annealing, chilling, tempering and ageing. The program allows anticipating durability, residuals stresses, chilling deformations and mechanicals and materials characteristics.

2. USING DEFORM AS A PARAMETER PROVIDER FOR FLOW SIMULATION

Integrating wear models from the cutting tools in numerical finite element calculus for estimating wear geometry of the cutting tools from uncovered carbide. Most of the other cutting models can't give a direct estimation of the cutting tool's wear and also can't update the cutting tool's geometry to real scale.

Solid models that can anticipate cutting tools wear using finite elements can: reduce necessary experimental tests number; make it easier for the chip's breakage and the cutting edge of the cutting tool; helps to understanding the wear effect of the cutting tool over the residual stress and other surfaces features; helps determine wear constants associated with different wear models of the cutting tool by calibrating cutting experiences with finite elements simulations; helps validate the prediction methodology of the wear cutting tool geometry depending on the cutting conditions and compares the simulation results to the experimental measures.

The cutting process analyses using DEFORM software gives complementary parameters necessary to create the parametric model in Witness (Minciu et al., 2008). Establishing the functional parameters in Witness, at the working point, for the tool exchanging times is made by using data obtained for the process simulation (Cotet et al., 2007).

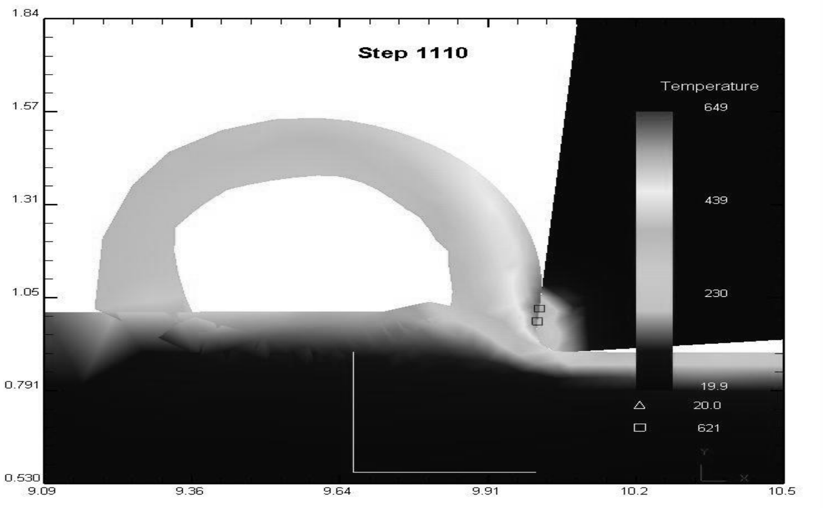

Fig. 1. Temperatures distribution for cutting speeds of de 400 m/min after 0.00152 seconds of simulation

For the studied model, after a number of working cycles, the tool will be exchanged before the working cycle, in which interval its life time will expire, due to the calculated durability.

3. THE EXCHANGE PARAMETERS ALGORITHM

Choosing the optimum architecture for the studied system is based on cutting tools flow optimization correlated with blanks and piece's flows and cutting processes optimization at working points. The system designed in Witness is made of a machine tool (lathe turret machine) supplied with a chain type tool storage room. For transporting the blanks we considered a conveyor belt (the input conveyor belt from b1 deposit is named c2 and the conveyor belt for manufactured pieces towards b4 deposit is c4 in the model).

Tool fitting is made by the same robot that feeds the machine tool with blanks (marked I in the model).

For the simulation we need to know the operating times (cutting process duration plus auxiliary times), the time interval after which the tool needs to be changed (tool's durability), the tool's exchange time (see fig. 2). The supplying with new tools is done in the model from depscn deposit (new tools deposit) and the used tools are put in the depscu deposit (used tools deposit). With the help of a flow simulation we will be able to identify the flow concentrator and give a diagnostic regarding the system's productivity. After eliminating this concentrator we will run a new simulation thus, establishing the productivity for the optimized system.

This kind of optimization involves an efficiency manipulation of the materials, lowering transport time and the waiting queues. In this way we can lower the manufacturing cycle, the production will be more efficient, increasing the on time delivery performance and the product's quality.

The biggest part of the research in this aria were focused on identifying and eliminating the flow concentrators for blank transporting disregarding the possibility for tools transporting and their exchanging when used. The results obtained after the process simulation will be considered as entry data for the flow simulation, in this way quantizing the choosing of an optimized architecture for this kind of system.

The simulation of materials flow using discrete values can only be done in Witness in real time, accelerated time (if we want to visualize the system's behavior in time), or in de-accelerated time (for particularization of the actions that lead to a critical moment in functioning). We choose an accelerated simulation, for a time interval of 240 hours in attempt of an optimization for medium time in this flow's functioning. From the calculus algorithms based on rapports given by Witness, the conveyor belt c4 is the flow concentrator. By eliminating the flow concentrator (doubling the c4 conveyor belt capacity), the number of pieces manufactured on the studied time interval will increase by 20%.

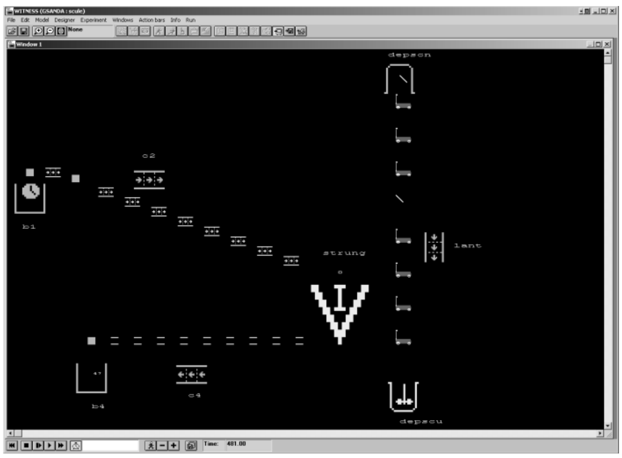

Fig. 2. System architecture at 481 minutes

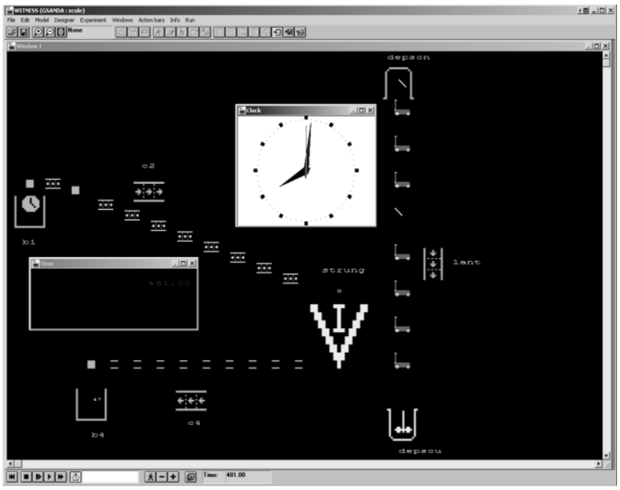

Fig. 3. Synchronizing material flow & process times after 481 minutes of simulation

4. CONCLUSION

Up to now the studies made refer to identifying the flow concentrator for a flexible system and eliminating it by modifying the number of working points for balancing the traffic.

The new aspect proposed by this paper consists of the flow regulation not by modifying the number of working points or structural modifications, but through correlation between process simulation and flow simulation at working point level.

The objective of this paper was to choose an optimum architecture for a flexible fabrication system by eliminating the flow concentrators as a result of a double modeling analyze type for a working system. After the flow simulation we will identify the flow concentrators and then give a diagnostic for the system's productivity.

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