Integrated Machine Tool Design

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Abstract
Today's global market is fiercely competitive. This circumstance, combined with increasing pace of technological development and customers demanding high-quality custom or semi-custom solutions, produces a highly dynamic engineering context. For example, aeronautical sector requires high-performance machining of innovative hard materials, both metallic (titanium) and composite, therefore the objective to decrease the manufacturing time and costs becomes a hard challenge that can be tackled only with a proper research effort. According to the classical approach, machine tools designers are supported only by CAD and FEA software, but when performance specifications become particularly demanding, those software aren't able to estimate with the required level of uncertainty the final effect of alternative design choices: in these cases, new techniques are necessary to allow a direct evaluation of performance required by the customer (e.g. material removal capacity, tracking accuracy,…), reducing therefore the risk of product failure already from the first prototype. New software tools and methodologies, available today, allow, by integrated simulation models, to analyze the complex interaction between machine structure (represented by a FE model), control system, cutting process. This paper exploit this approach and outlines a design methodology that permits the estimation of the final machine performance and the identification of the components that mainly concur in limiting them. The proposed approach is applied to propose structural and control modification to a machining center.

Keywords:
machine tools, design tools, virtual prototyping