

Dissertation title:

A model for energetic analysis and evaluation of vacuum gripping systems

Florian Fritz

Increasing energy costs as well as growing social demands for a sustainable production fostered measures to reduce energy consumption in all areas of industry and established energy efficiency as one differentiator in marketing of industrial products and production machines. However, in vacuum gripping technology is a general deficit in systematic design of gripping system perceptible and the energy consumption respectively the energy efficiency is insufficiently taken into account in existing design approaches. To overcome this lack, researching energetic processes of vacuum gripping systems and developing a scheme to evaluate the energy consumption during the configuration process was defined as the scope of this dissertation.

In regards of the identified deficits in existing approaches and based on the explained basics as well as the defined requirements, a two-phase analysis and evaluation model for vacuum gripping systems has been designed. The first phase was designed in a way that energetic relations of components of vacuum gripping systems were analyzed and modelled within this phase. At first, energy related process and system parameter were determined which served as a basis for the energetic analysis for the single systems components. The analysis included comprehensive experiments with measurements as well as theoretical and simulation-based investigations. Based on the knowledge that has been gained during the analysis, modeling methods for the fluidic, structural mechanics and energetic characteristics of every component that influences the energy consumption has been developed. Every chapter of modelling is completed by a successful validation of the modelling method and the evidence of the model's feasibility. In the second phase a procedure for energetic evaluation of vacuum gripping systems is developed that is used during the configuration process of a system and that enables a systematic increase of the system's energy efficiency. The procedure was designed in a way that the knowledge of the energetic processes that was obtained in the first phase is utilized during the configuration. Since different forms of energy may be applied to the systems, it was necessary to create a method that allows to compare energy values not only physically but also technically with respect to peripheral processes. Finally, the procedure for energetic evaluation of vacuum gripping systems was implemented and it was validated by means of realistic applications of the industrial practice. On this occasion, it could be verified that this procedure represents a helpful measure in designing energy efficient vacuum

gripping systems. The results of the validation illustrated the necessity of an energetic evaluation of gripping systems during the configuration process through the significant differences in the systems' energy consumptions