Method to Couple Several Miniature Oscillating Conveyors to a Feeding System

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Abstract

This article presents an integrated system of several miniature oscillating conveyors which will allow to separate and to sort all types of micro parts. The conveyor panels are placed next to each other composing a form of panel-carpet. In order to couple the independet oscillating conveyors to a feeding system, the clearance between two conveyor panels at a time needs to be safely bridged. Different concepts are analysed in this respect to transport parts safely from one conveyor panel to the next one.

1 Introduction

The costs incurred by feeding technology are particularly high with regards to micro assembly as the respective handling tools need to be adjusted to every single part and are flexible only to a certain degree [1]. The Institute of Production Science at the Karlsruhe Institut of Technology (KIT) has developed a piezo driven micro 3D vibrating conveyor for the flexible handling of micro parts [2]. Combined with a computer-aided system the vibrating conveyor allows for the flexible positioning and orienting of a wide range of different micro parts irrespective of their shape and geometry just by adjusting magnitude and phase of the oscillation. The spectrum of parts ranges from a micro-cog up to a pencil (mass ratio: 1:10000).

2 Integrated feeder system for the handling of micro parts

The integrated feeder system consists of several miniature oscillating conveyors which, in addition, will allow to separate and to sort all types of micro parts (figure 1, left). In this particular case, the system consists of four oscillating conveyors whose hexagonal conveyor panels are placed next to each other. Each conveyor is driven by its own piezo actuators and is controlled individually. Furthermore, the system is equipped with an optical image processing system which enables the detection of type and position of the parts residing on the conveyor panels. In Fig. 1 each part extracted from the magazine (separation) can be conveyed to a certain panel. Depending on its type it is possible to transfer the part to a specific magazine (sort) or to submit the part to quality control. Hereby rejected parts are discarded, accepted parts on the other hand are transferred to the adjacent panel to be positioned and orientated for an assembly gripper. In the first step, a system was set up that contains two oscillating conveyors (Figure 1, right).

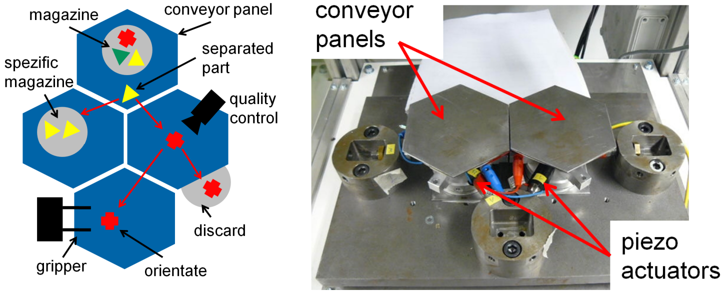

Figure 1: Feeder system composed of several coupled miniature oscillating conveyors

2.1 Bridging the gap

In order to couple the oscillating conveyors to a feeder system it must be ensured that every component from the spectrum of parts is able to overcome the gap between the conveyor panels. It is important to ensure that it will still be possible to excite the feeder plates independently from one another. This article presents three different concepts to bridge the gap. All three approaches will be tested with the help of prototypes. Different types of micro parts will be transported by the feeder, and the quality of each concept will be evaluated for each type of part on the basis of pre-defined criteria.

2.1.1 Bridge

The first concept uses a simple bridge such as a thin metal plate between the conveyors (figure 2).

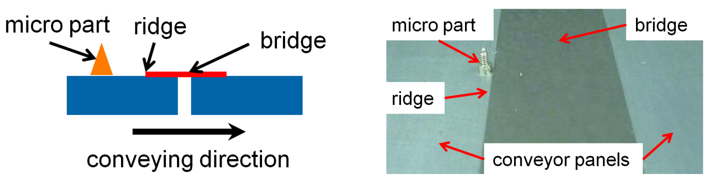

Figure 2: Gap transition in form of a thin metal plate

In this case it is important to achieve the transition from the conveyor panel to the bridge. However, only a few parts are able to overcome the ridge of the metal plate. Therefore, the bridge is integrated into one of the feeder plates. The opposite feeder plate must be positioned a little bit below or must be equipped with a ramp (figure 3). Then, all parts can be transported to the adjoining plate without any problems. However, this gap transition is not reversible (one-way street).

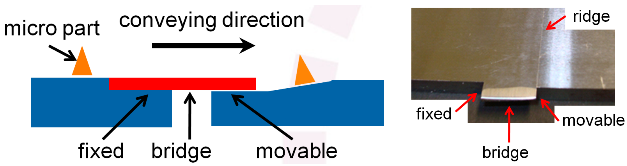

Figure 3: Gap transition with a bridge integrated into the feeder plates

A reversible gap transition is a plastic foil which is stuck onto all feeder plates enabling the parts to slide across the gap (figure 4). In order to maintain the flexibility of the gap, the foil must have a certain level of elasticity. In addition, adhesive forces have to be taken into consideration as they interfere with the feeding process, which is particularly true for the transportation of small plastic parts.

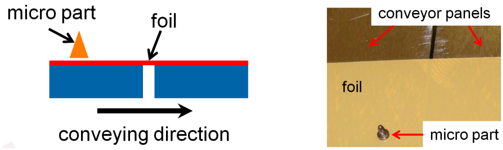

Figure 4: Gap transition with a plastic foil stuck onto the feeder plates

2.1.2 Elastic material

The second concept achieves the gap transition by means of elastic material placed inside the gap (figure 5). However, this approach is problematic due to the ridge transition between different types of material and the consistency of the elastic material, which dampens the oscillation.

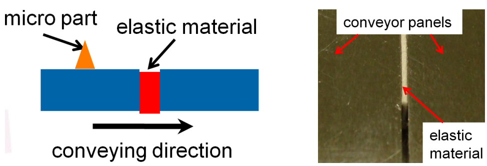

Figure 5: Gap transition by means of elastic material

2.1.3 Active gap control

The intention of the active gap control is to reduce the clearance between two adjacent panels by matching their oscillation (figure 6, left). The active gap control is tested in form of two rigidly connected feeder plates with a defined gap in between (figure 6, right). Even though the gap can be crossed by most of the parts without major problems, the tests suggest that successful transition in case of very small micro parts depends on the structure of the conveyor panal ridges which must be subjected to a thorough examination.

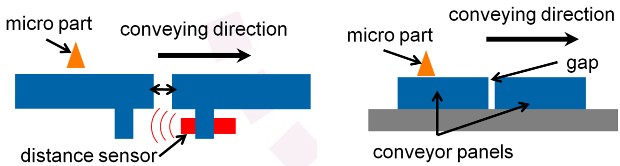

Figure 6: Active gap control

3 Summary and outlook

The bridge integrated into the feeder plate is a simple but inflexible solution. Both the foil and the active gap control represent the most promising approaches. The foil is easy to construct, but the foil must have a certain level of elasticity, and potential adhesive forces must not interfere with the feeding process. With regards to the active gap control, special attention must be given to the conveyor panel ridges if the micro parts are very small. However, it is already possible to transport almost the whole spectrum of parts from one panel to the adjacent.

A reliable gap transition allows the combination of several oscillating conveyors into an integrated feeder system. Due to its modular setup the system not only renders for the flexible positioning and orienting but also the separating and sorting of a wide range of different micro parts (mass ratio of the micro cog to the pencil: 1:10000) irrespective of their shape and geometry.

References:

[1] Sanchez, S.A.J., et al.: *Recent development in micro-handling systems for micro-manufacturing.* Journal of Materials Processing Technology, Bd. 167 (2005), H. 2-3, S. 499-507.

[2] Munzinger, C.; Tröndle, M.: *Flexible handling of micro parts with oscillating conveyors. Positioning and orientating micro parts without devices.* In: wt Werkstattstechnik online, Jahrgang 98 (2008), H. 9, S. 697-700.