Improving Performance of Inkjet Printing Systems by Means of Low-cost Mechatronics

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1 Introduction

Our research aims at increasing the performance of inkjet printers, while minimizing the cost price. The focus of the research is on mastering the 6 DOF’s of all printheads in a multiple printhead, wide format, inkjet printer. Low-cost mechatronics will be applied to deal with cost and quality issues when the productivity is increased. Every printer company most likely carries out research on productivity, however not much has been published on this for confidentiality reasons. In [1], a description of a productivity model is presented. It deals with design parameters regarding heat management in contrast with our research which will primarily deal with mechanical design parameters.

2 Productivity

An increase of productivity \( P \) (amount of printed surface area per unit of time) can be achieved by:

- Increasing the total amount of nozzles \( N \): more nozzles in each printhead or more printheads.

\[
\begin{align*}
  f &= \frac{f_{p_0}}{P_{s}^{0.2}} \frac{F_{c}(x_{c}+y_{c})}{2m_{c}f_{c}(x_{c}+y_{c})^{2}r_{c}^{2}} \\
  P &= \frac{N_{c}^{2}}{16} f_{c}(x_{c}+y_{c})^{2}r_{c}^{2}
\end{align*}
\]

![Figure 1: Productivity (in \( \frac{m/s}{mm} \) dependencies: max. actuator force \( F_c \), carriage size \((x_{c}, y_{c})\), and mass \( m_{c} \), interlacing \( p_{c} \), paper format \((x_{p}, y_{p})\), print resolution \((r_{x}, r_{y})\).](image)

- Increasing the jet frequency \( f \), the amount of ink drops fired per unit of time.

The carriage becomes larger and faster when the productivity is increased, which results in efficiency and print quality loss. Efficiency is determined by several design parameters as shown in Figure 1. For improving print quality, a candidate solution is presented next.

3 Feedback control printhead alignment

A larger and faster carriage increases printhead misalignment and efficiency loss. Instead of decreasing manufacturing tolerances, which is expensive, an absolute reference is created by measuring the position of a string such that the carriage and/or printheads can be aligned using feedback control (see Figure 2). This also enables staggering of printheads in the paper transport direction, where an absolute reference is essential.

![Figure 2: Feedback control printhead alignment: The position of a thin string is measured with an accuracy of 10 µm and feedback control will be applied to align the carriage and/or printheads.](image)

4 Future work

The upcoming year, two candidate solutions (one is described above), will be investigated in detail. Models for simulation and prototypes will be built to test feasibility.

References