

Date November 19, 2013

Re:

## Recommendation

Mr. Pieterjan Bartels was a research trainee under my supervision from June 26, 2013 till August 2, 2013 in the R&D/Prepress Department of Agfa Graphics N.V. The subject of the internship was "Embedding data in a curve by varying its thickness". The aim was to design and implement algorithms to encode information along a curve by varying its thickness and to retrieve it based on a digital image of a printed copy.

From the first day Pieterjan was given the idea to check if data could be embedded along curves for security printing applications, he started to create a framework to design and detect curves in images in a flexible way. This was based on the UI framework available for Mac OS X whereas for the image processing operations OpenCV was used.

Even though the project only lasted about one month, Pieterjan obtained excellent results with a minimum of support mainly due to his software knowledge. Within two weeks, he was able to deliver a working application on Mac to create and process curves with embedded information, and started testing it in practice.

Also his competences in problem analysis are well-developed. During the last three weeks, Pieterjan was able to modify and fine-tune his design to make it robust for typical degradations of both printing and capturing devices used in the experiment. In practice, prints were generated with a simple laser printer whereas digital images were obtained by Android smartphones and Apple iPhones. Not only the image processing was optimized to detect the data efficiently but also coding theory was applied to recover missing bits.

In general, Pieterjan was always well-focused on the project, he was a very good candidate.



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