Implementation, modeling, and exploration of precision visual servo systems

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Researcher Zhenyu Ye. Credit: Eindhoven University of Technology

Researcher Zhenyu Ye has made a set of methods that can help designers to make incremental improvements on existing (smart) machines, and to explore new possibilities in their future products. He will defend his Ph.D. on May 26th.

Automation and improvements of efficiency are key enablers of economic growth, a higher standard of living, and well-being of individuals. As we have witnessed in the third industrial revolution, computing and communication technology have significantly improved the productivity of our society. However, growth cannot be sustained without new innovations. More specifically, innovations are needed for tackling certain daunting challenges of automation that were technically infeasible in the past but are ripe for investigation in the short term future. One of these innovations needed is to build smart machines that can see, think, and act, with a high speed and a high accuracy. Several key challenges that hinder this innovation are investigated and resolved in this thesis.

These challenges are induced by constraints in the speed of camera, the speed of computation, the speed and accuracy of vision algorithms, and a lack of methods to effectively compensate for these constraints and to find out a good overall solution within these constraints. In this thesis, methods are provided to design high-speed vision systems, to evaluate delay and accuracy of vision algorithms, to design control laws that compensate for these constraints, and to find out among a large number of design options which is most suitable for a specific use case. These methods are applied to an industrial use case, in which they are demonstrated to be effective and offer significant improvements over an ad-hoc design.

By overcoming these challenges, this thesis has demonstrated that it is feasible to build a smart machine with a high speed and a high accuracy, and has provided a set of methods that can help designers achieve this goal. Perhaps such a smart machine is still ahead of its time. However, designers can use the methods provided in this thesis to make incremental improvements on existing machines, and to explore new possibilities in their future products. In such a way, this thesis has made the eventual realization of smart machines one step closer. Hopefully, my fellow researchers, engineers, and entrepreneurs will carry on with this journey and make it part of the next industrial revolution. That is when this thesis brings its full value for our society.

Provided by Eindhoven University of Technology