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INTRODUCTION

This poster presents an application of Computational Fluid Dynamics (CFD) analysis to evaluate possible performance improvements of fan and cleaning system in a combine harvester.
CFD simulation has been extensively used for many years for automotive and aerospace applications, while it is not widely applied yet in agricultural fields, despite the technology maturity and the huge potential related to its usage.

Images of the combine harvester (upper) and detail of the fan and cleaning system (lower)
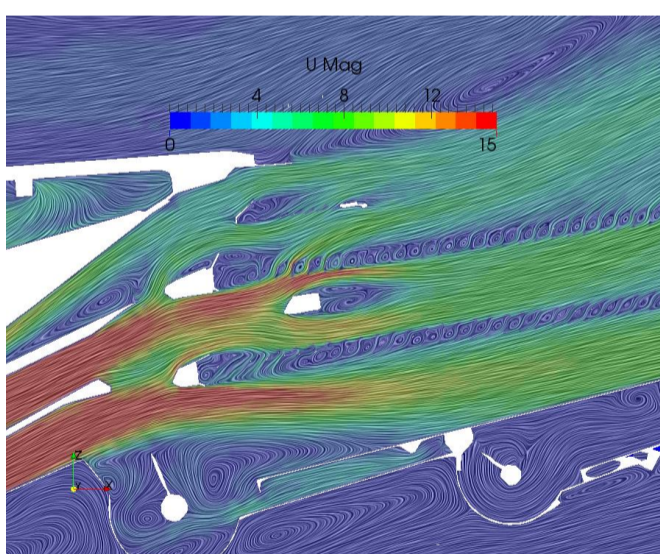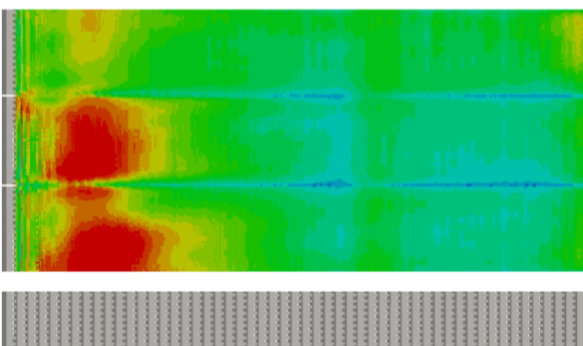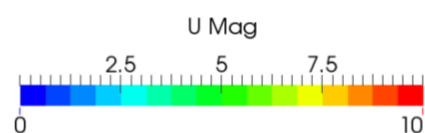
Images of air flow distribution through the sieves (upper) and detail of the distribution region (lower)

The combine harvester is a complex machine designed to harvest a variety of different grain crops and capable of efficiently combining different operations into a single process.

During separation, the last stage of impurity removal and grain cleaning is achieved by a combination of mechanical shaking of the sieves and the passage of fast-moving air through them, in order to evacuate the lighter impurities (i.e. light straw and chaff) out of the harvester while collecting the heavier grains.

The key to optimal performance - both in terms of separation and energetic efficiency - is then related to the correct distribution of the air flows inside the air-to-screen system, resulting from the coupling of the fan and the distribution channels.

The empirical analysis and optimization of systems of this complexity is a long-taking process, mainly based on trial-and-error.

The application of CFD virtual simulation can dramatically shorten this optimization process, due to its twofold advantage:

- Easy identification of the 'critical' areas to be optimized, thanks to a comprehensive vision of the fluid movement inside the system, reproduced with great accuracy, despite of the geometrical and physical complexity of these problems,
- Fast setup and virtual testing of different configurations, to easily and quickly explore the effects of new designs, without the need of building costly prototypes.

The activity, carried out with the simulation tool IconCFD v3.3, was developed with the support of Same Deutz-Fahr combine harvester division, and allowed to build a complex model of a combine harvester, run the simulation and collect data to understand the potential improvements to be applied to the separation system.

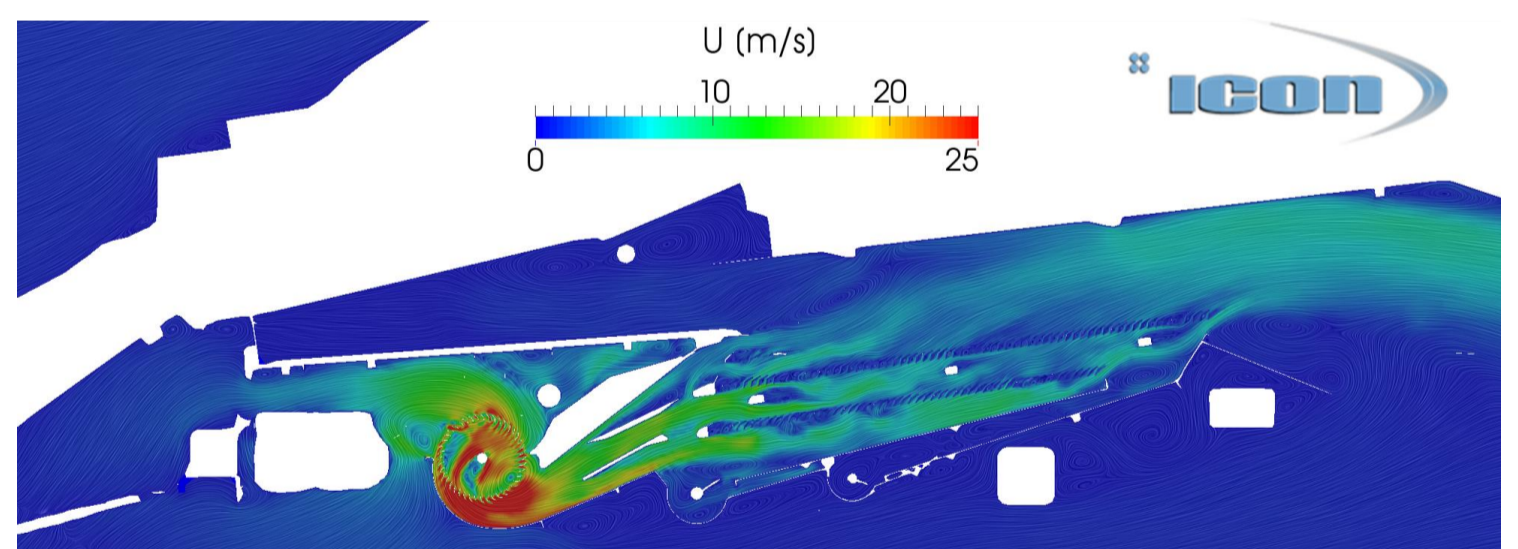The highlighted possible improvements will be tested experimentally.

Image of the air velocity magnitude inside the harvester.

CONCLUSIONS AND PERSPECTIVES

The huge and yet not completely exploited potential of CFD simulation in the agriculture field allows a drastic reduction of the design and optimization process time.
A complex and complete virtual model of the combine harvester has been developed to predict the behavior of the air flow inside the air-to-screen cleaning system. Starting from the results of the analysis, some measures to further improve the overall separation performance have been highlighted and their effectiveness will be validated empirically.