Zur Optimierung des Gleichdralldoppelschneckenkneters o(de)r: Towards mixing analysis of twin screw extruders

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Zur Optimierung des Gleichdralldoppelschneckenkneters

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Problem definition
In industry, production speed is an important issue. For polymer processing equipment this means that the time for polymer granulate to melt, mix with additives or colourants and homogenise should decrease.

Current approach
Flow fields in complex polymer processing equipment can be determined by finite element methods. However, once velocity field and pressure drop are computed [1, 2], the question remains what to do with the results. Currently, results are mainly used to plot particle trajectories, as e.g. shown in figure 1.

Approach suggested
Instead of computing trajectories for a (huge) number of particles, the boundaries of a set of smaller domains, that together completely fill the flow domain or a cross section of it, are tracked for a characteristic time or length of the flow and then compared to the original subdivision. A transport or mapping matrix is constructed that describes the transformation of the original grid to the tracked and deformed grid. This approach [3], has proven to give good results for a number of 2D and 3D flows as e.g. the lid driven cavity (fig. 2) in two and three dimensions, and the multiflux static mixer (fig. 3).

Fig. 2 Mixing patterns in a lid driven cavity (benchmark problem) computed with the mapping method

Fig. 3 Layer distribution in a multiflux static mixer computed with the mapping method

However, for a flow problem with a continuously changing flow domain, the map is less trivial and still subject to research.

Conclusions and future work
The mapping method is the only method so far that allows for a fast and feasible analysis of mixing flows. Obviously, the principal challenge in the analysis of mixing in twin screw extruders lies in the determination and interpretation of mapping matrices for various elements as shown in the screws along the side.

References: