Application of interval arithmetics for exploring feasibility region of extractive distillation

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Interval arithmetic can be successfully applied to find all the solutions of systems of nonlinear equations in a given region with mathematical certainty. Not finding any solution means non-existence of solutions in the studied region. The mathematical certainty, provided by the method, makes interval arithmetic a powerful tool for solving problems from the field of science and engineering. Conventional methodologies require far less computation time but they may diverge, or find a local solution only. Existence or non-existence of a solution in a given region is the key for decision in some chemical engineering applications. One of such chemical engineering problems is the feasibility of extractive distillation and calculation its limiting flows.

There are several variants of the extractive distillation processes, including continuous and batch processes, homogeneous and heterogeneous liquid phases, presence of positive or negative azeotropes, volatility of the entrainer, and distillation column structure.

Feasibility study of extractive distillation can be done by analysing profile maps. Existence and location of singular points and separatrices in these maps are determined by the process parameters. The limiting flows of the process belong to those parameter values at which the structure of the map changes. These data can be roughly estimated by graphical tools, but cannot be determined with certainty.

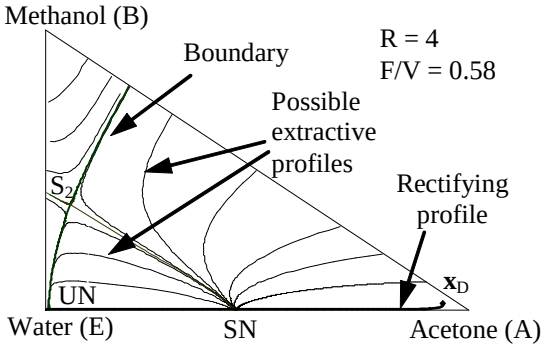

Figure: Profile map with feasible parameters of a particular process

One cannot be sure if a singular point exists or not, if not found. That is why we applied interval arithmetic: all the singular points of the maps are found in this way at specified process parameters. Limiting flows are determined with the same methodology by finding the bifurcation points and the corresponding parameter values.