UNIVERSITÄT DUISBURG ESSEN

COMPUTER SCIENCE AND APPLIED COGNITIVE SCIENCE

Computer Graphics, Digital Image Processing, Scientific Computing

A Verified MATLAB Implementation of Markov Set-Chains

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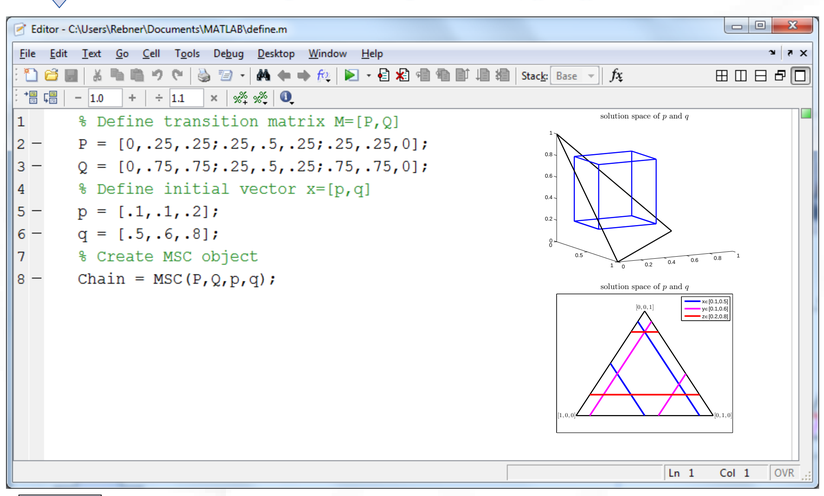
First Verified MSC Implementation

Aim: Integrate interval arithmetic features into Markov Set-Chains

- **MATLAB**
- **INTLAB:** Interval library

Define MSC

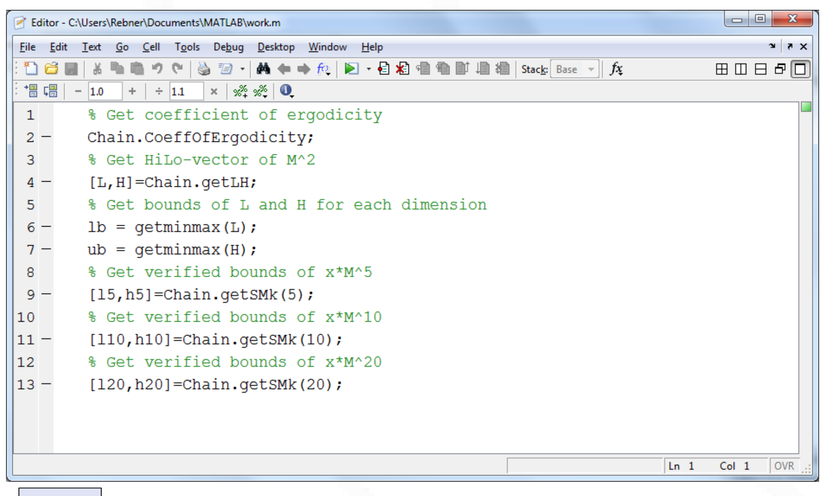


Uncertain parameters in

- Transition matrices
- Initial vectors

Handling of round-off errors

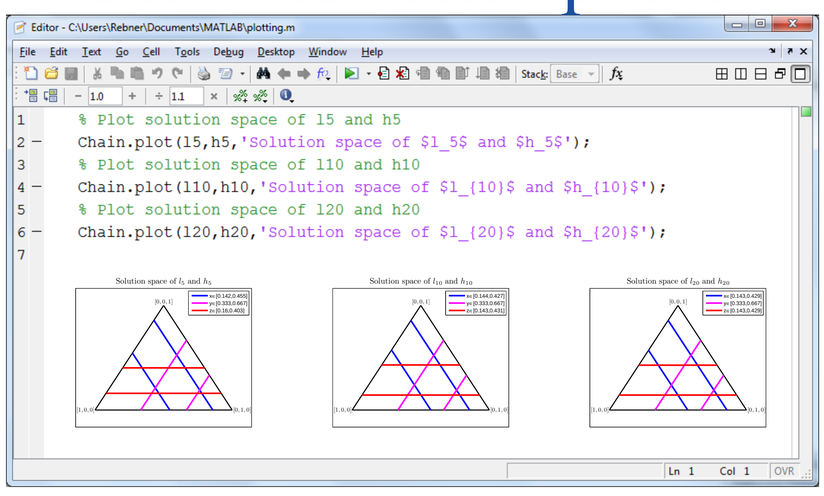
Work with MSCs



Verified Computation of

- HiLo - method
- Coefficient of ergodicity
- Vertices

Plot Solution Spaces



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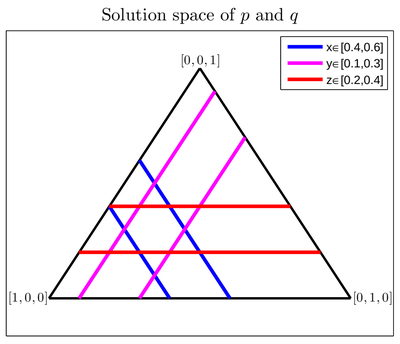
Example of ergodic MSC

Goal: Compute Limit Solution Space

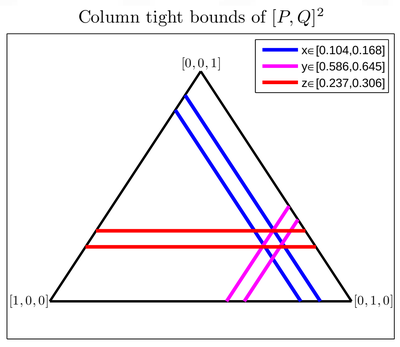
$$P = \begin{array}{c|ccc} & A & B & C \\ A & .423 & .459 & .043 \\ B & .029 & .677 & .222 \\ C & 0 & .478 & .461 \end{array} \qquad Q = \begin{array}{c|ccc} & A & B & C \\ A & .473 & .509 & .093 \\ B & .079 & .724 & .272 \\ C & .036 & .528 & .511 \end{array}$$

$$p = (.4 \quad .1 \quad .2) \qquad q = (.6 \quad .3 \quad .4)$$

Solution space of p and q

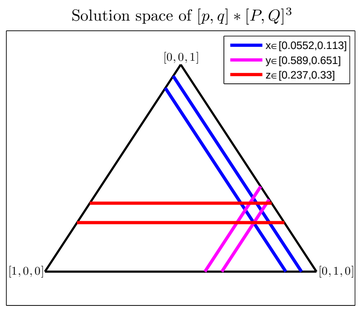


Column tight bounds of $[P, Q]^2$

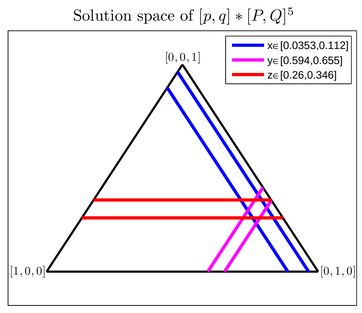


Column tight bounds of step 3, 5 and 10

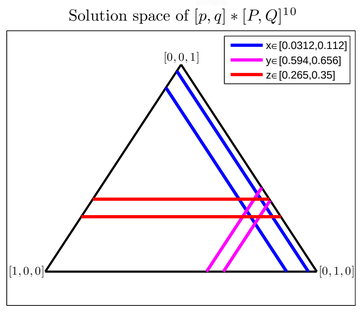
Solution space of $[p, q] * [P, Q]^3$



Solution space of $[p, q] * [P, Q]^5$



Solution space of $[p, q] * [P, Q]^{10}$



Advantages of MSC are:

- Verified results
- Unified treatment of uncertainty
- Fast function evaluation

Future work:

Application of verified MSC and fault tree analysis to modeling processes in SO fuel cells.