Fuzzy Set Shape Multi-Objective Optimization Applied on Macroeconomic Research

František Huňka

University of Ostrava

Jarmila Zimmermannová

Moravien University College Olomouc

Layout

- Introduction
- Language approximation
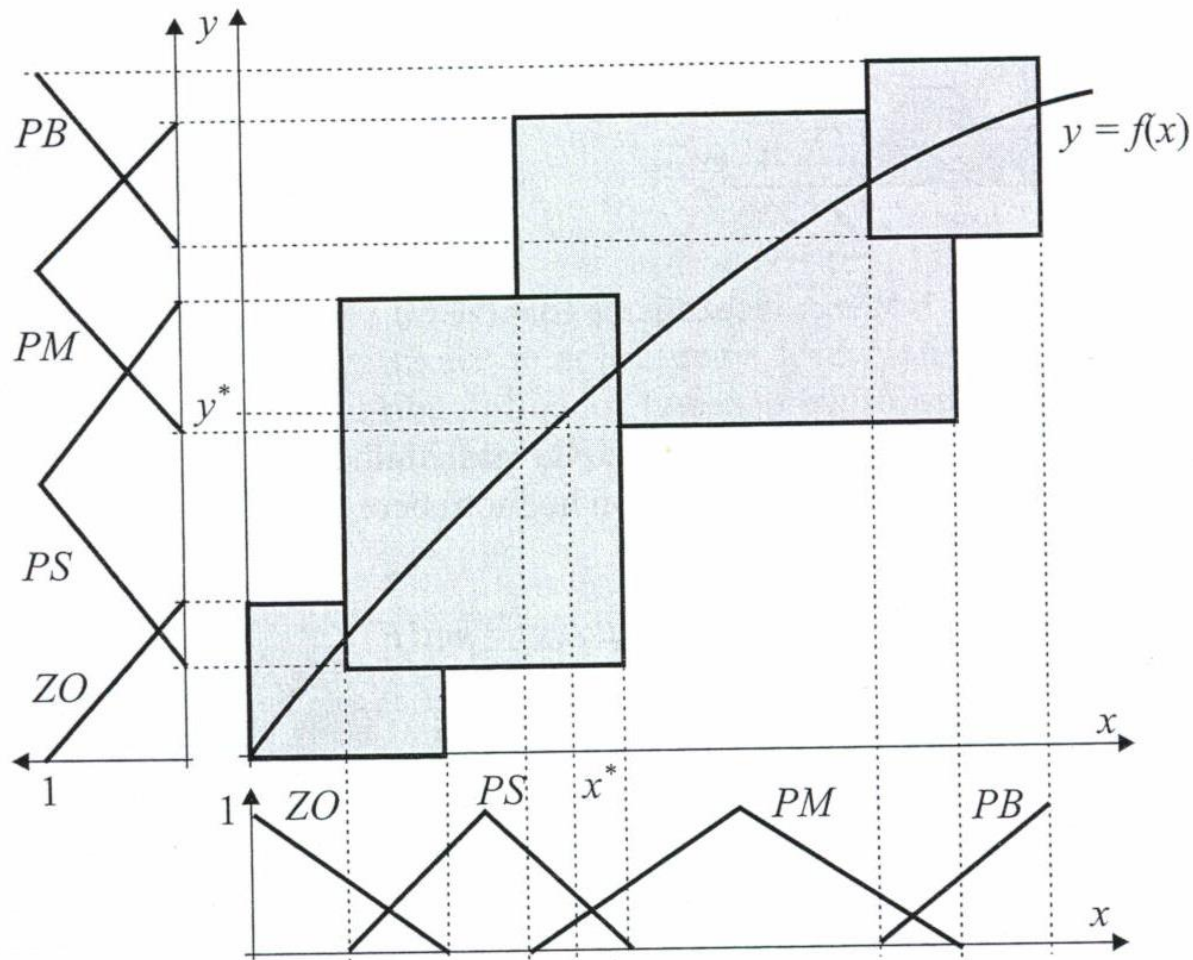- Multi-Objective Optimization
- Achieved Results
- Conclusion

Introduction

- Economic research of the total greenhouse gasses emission in the Czech Republic development and its in relation to GDP and energy intensity of GDP.

- Fuzzy approximation of these discrete measured values.

Language Approximation

- A number of approximated methods:
  - least square method, Chebyshev approximation, Fourier series

- Benefits of the approximation:
  - utilizing qualified knowledge of experts
 - local sensitivity for changes due to fuzzy sets

Language Approximation

Multi-Objective Optimization

- Optimization criteria:
  - accuracy
  - interpretability (distinquishability) of fuzzy sets
- Pareto-optimization approach
- Weighted sum of objective functions (accuracy, interpretability)
- Normalization

Multi-Objective Optimization

- Interpretability index:
  - neighboring pairs of fuzzy sets crossing points <0,25 – 0,75> without penalty
  - otherwise penalty
  - crossing point of not neighboring pairs of fuzzy sets: $(j - i)^2$
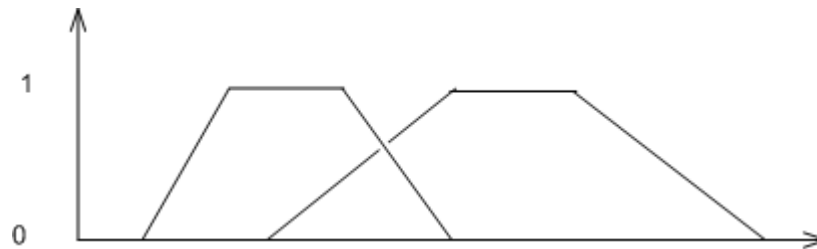
Rule Base Construction

IF *X* is *A1* then *Y* is *B1* AND

IF *X* is *A2* then *Y* is *B2* AND

IF *X* is *A3* then *Y* is *B3* AND

IF *X* is *A4* then *Y* is *B4* AND

IF *X* is *A5* then *Y* is *B3* AND

IF *X* is *A6* then *Y* is *B3* AND

IF *X* is *A7* then *Y* is *B3* AND

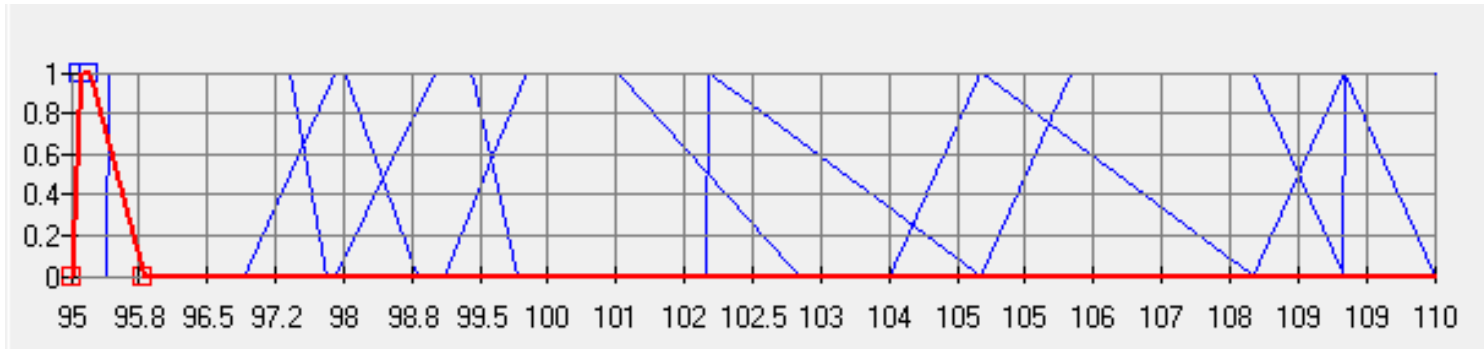IF *X* is *A8* then *Y* is *B3* AND

IF *X* is *A9* then *Y* is *B4* AND
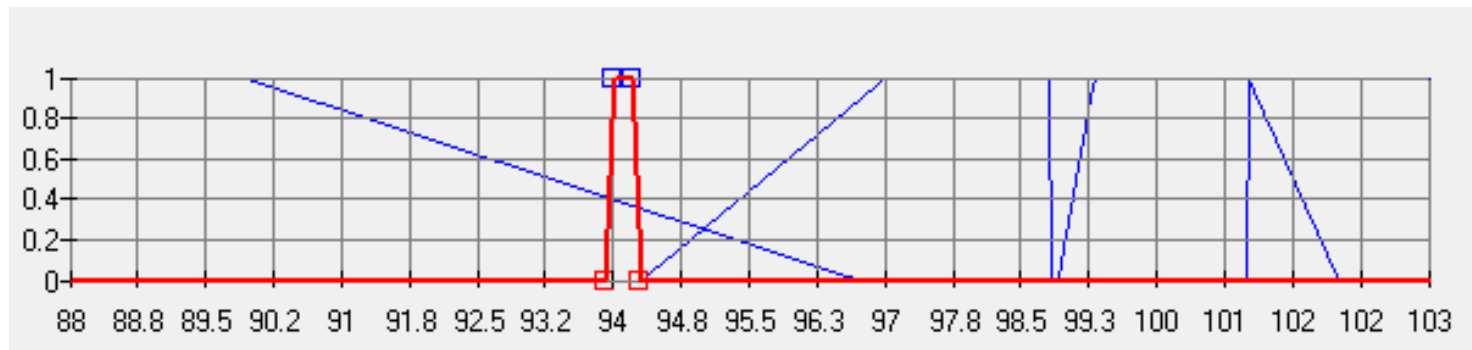
IF *X* is *A10* then *Y* is *B5*

- Weighted sum of objective functions: 0,3 – accuracy; 0,7 - interpretability
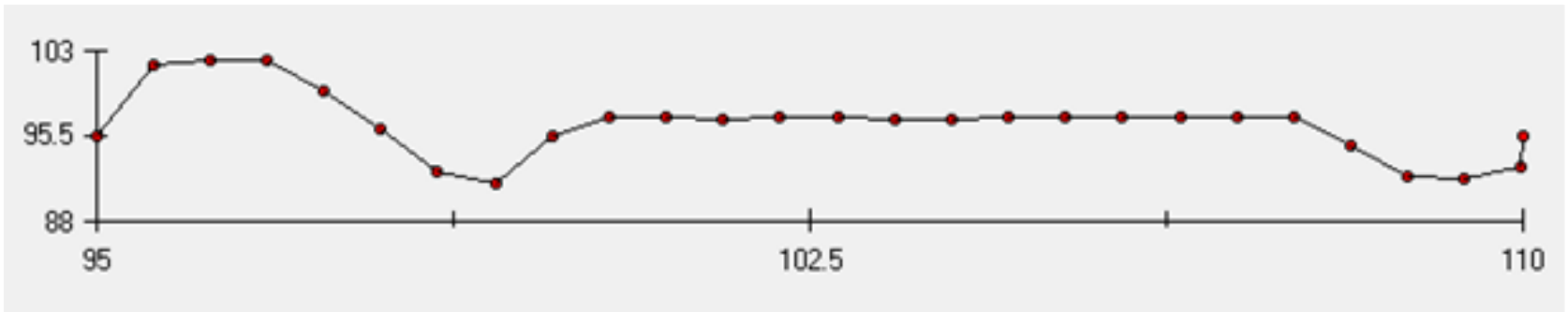
Achieved Results

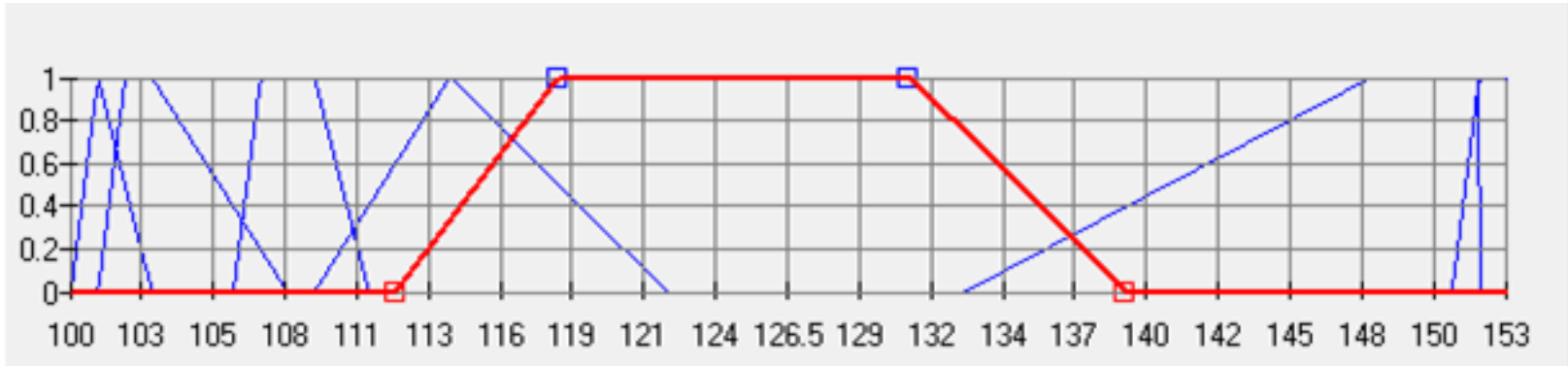Antecedent axis of the total greenhouses emission after optimization

Consequent axis of the total greenhouse gasses after optimization
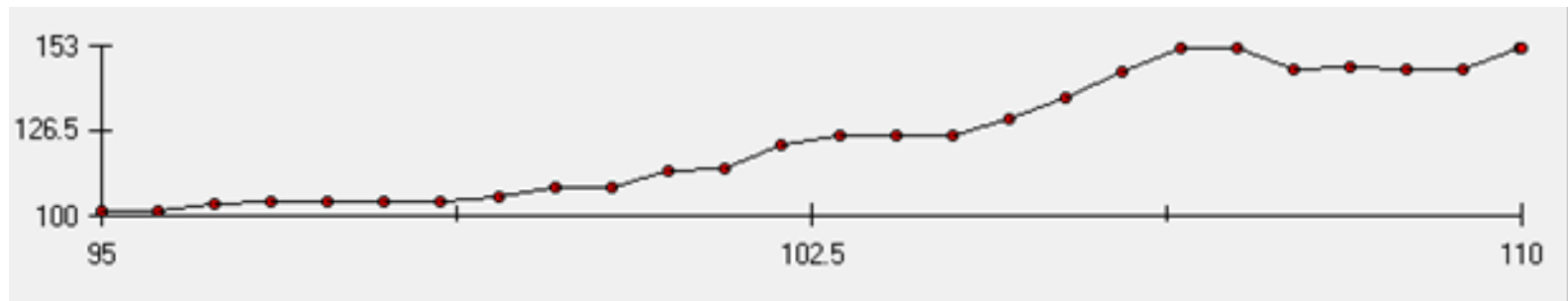
Achieved Results

A course of approximated function representing total greenhouse gasses emissions

Achieved Results

Consequent axis of GDP after optimization

A course of approximated function representing the development of GDP

Conclusion

- Language approximation proves to be sensitive to local changes owning to classical approaches.

- Weighted sum of objective functions proved to be suitable approach to optimization.

- Achieved results are promising for future research.