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A novel multi-objective optimization method for the pressurized reservoir in hydraulic robotics

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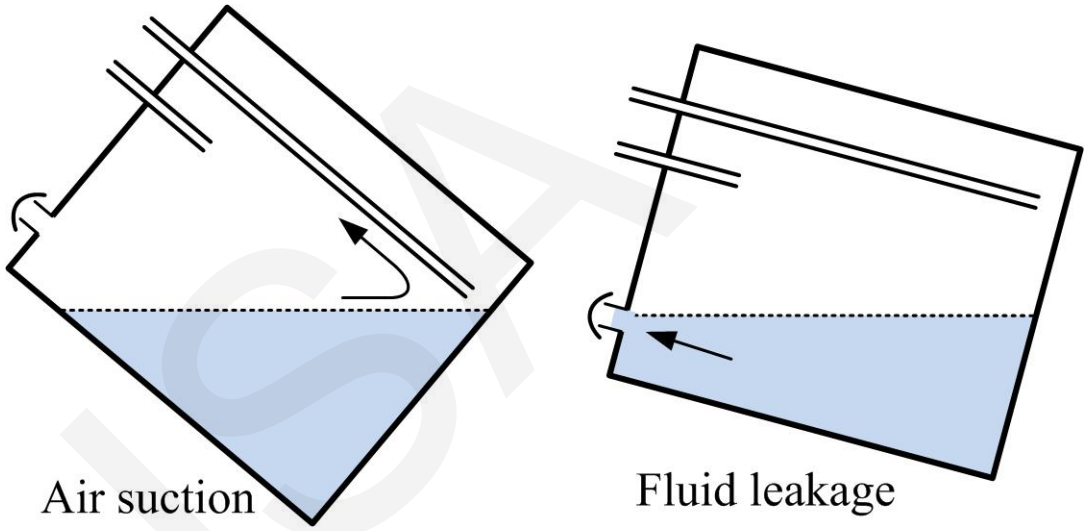
Reservoir in hydraulic robotics

Pressurized reservoir is necessary in hydraulic robotics by:

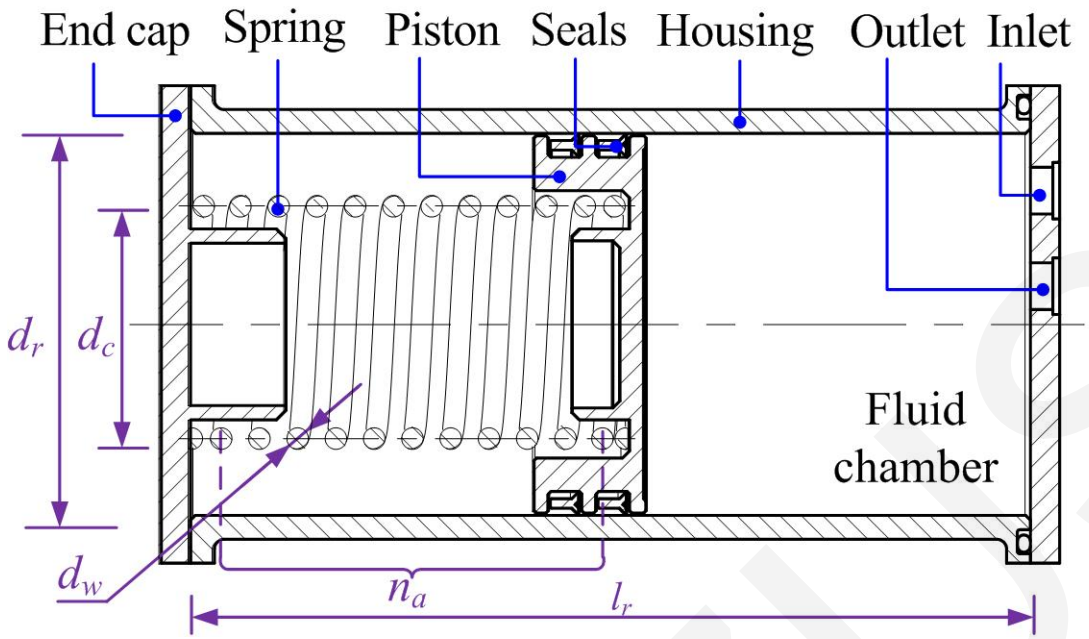


(1) Making the adoption of **high speed pumps** possible.

(2) Preventing **air suction** or **fluid leakage**, when the robot is moving.

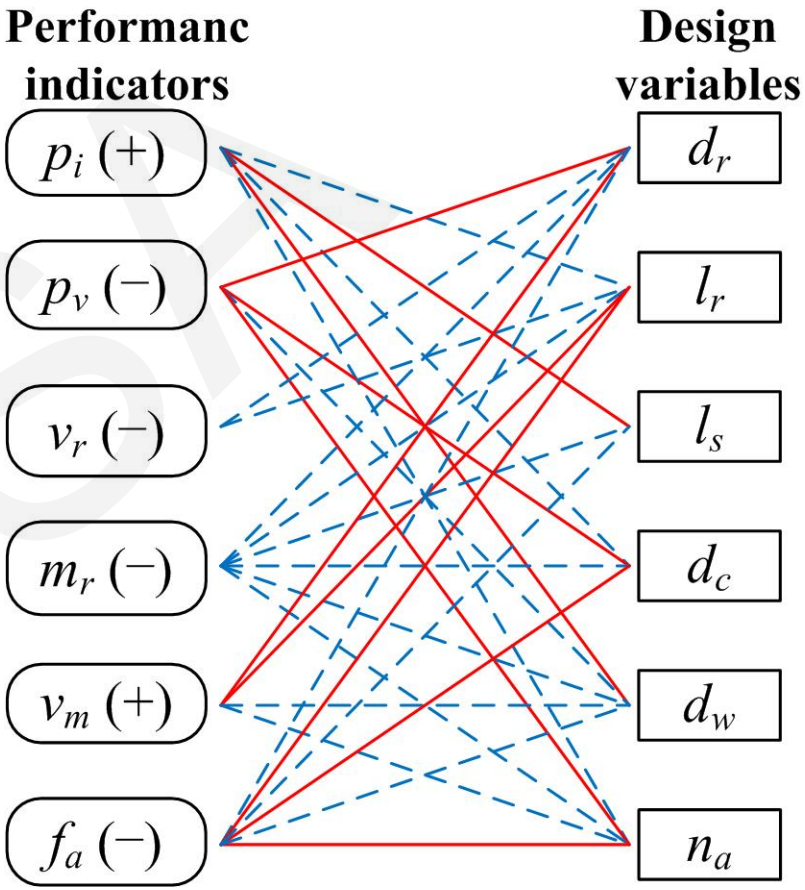
(3) Protecting the fluid from **contamination** in the air.

Reservoir in hydraulic robotics



A **spring pressurized reservoir** is a good choice for hydraulic robotics.

Analysis shows that its design is a **multi-objective optimization** problem.

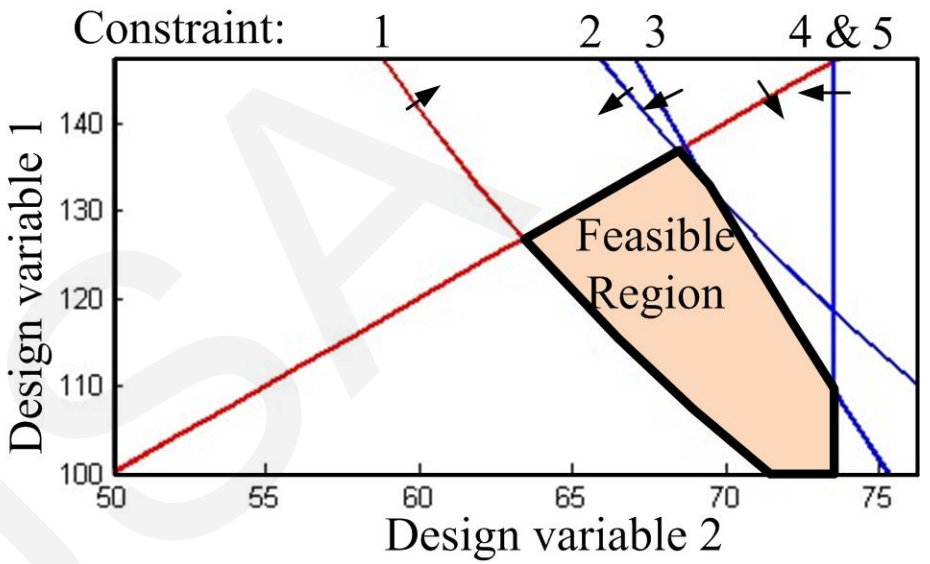


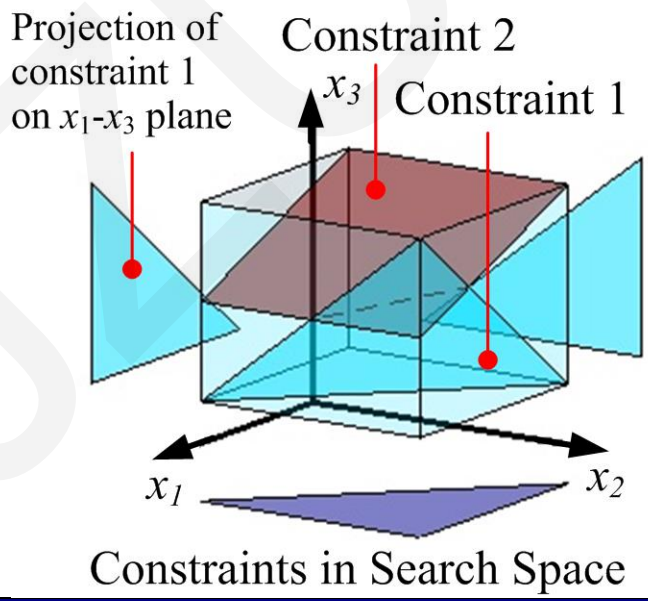
Performance indicator dependencies on design variables

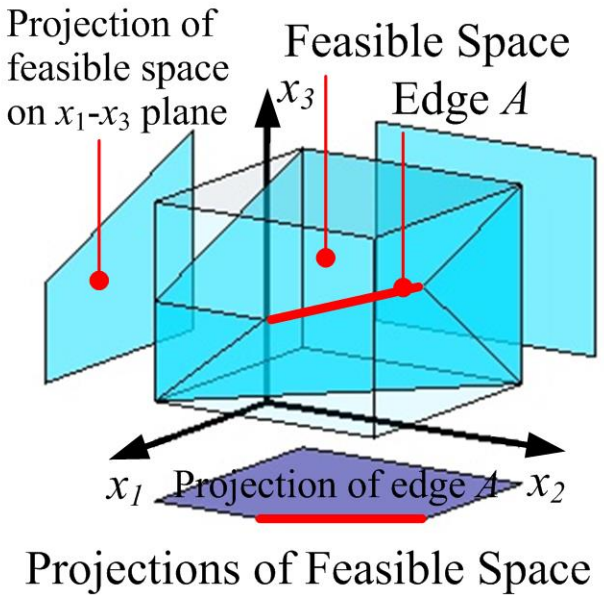
Multi-objective optimization

For a optimization problem with only two design variables, the feasible region can be easily found by assigning thresholds to the objectives.

Whereas in a problem with design variables more than two, it's not easy to get the feasible space analytically .

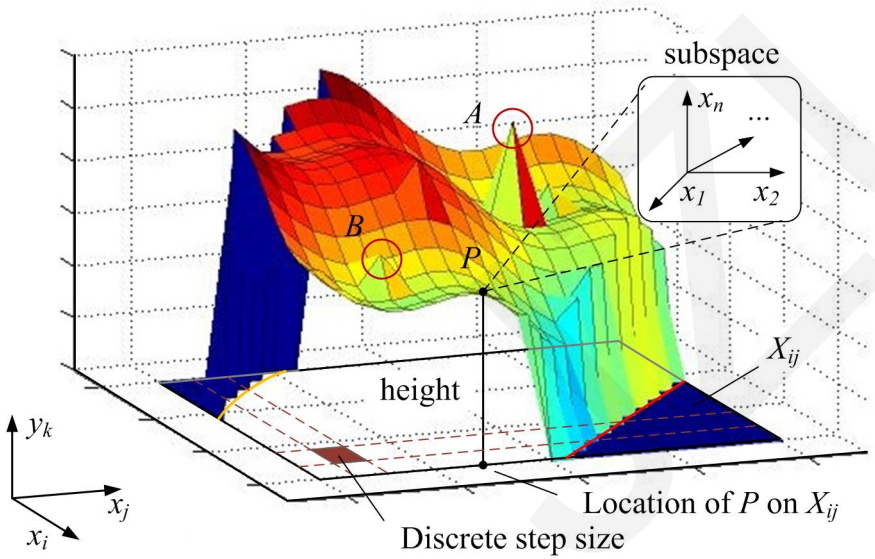




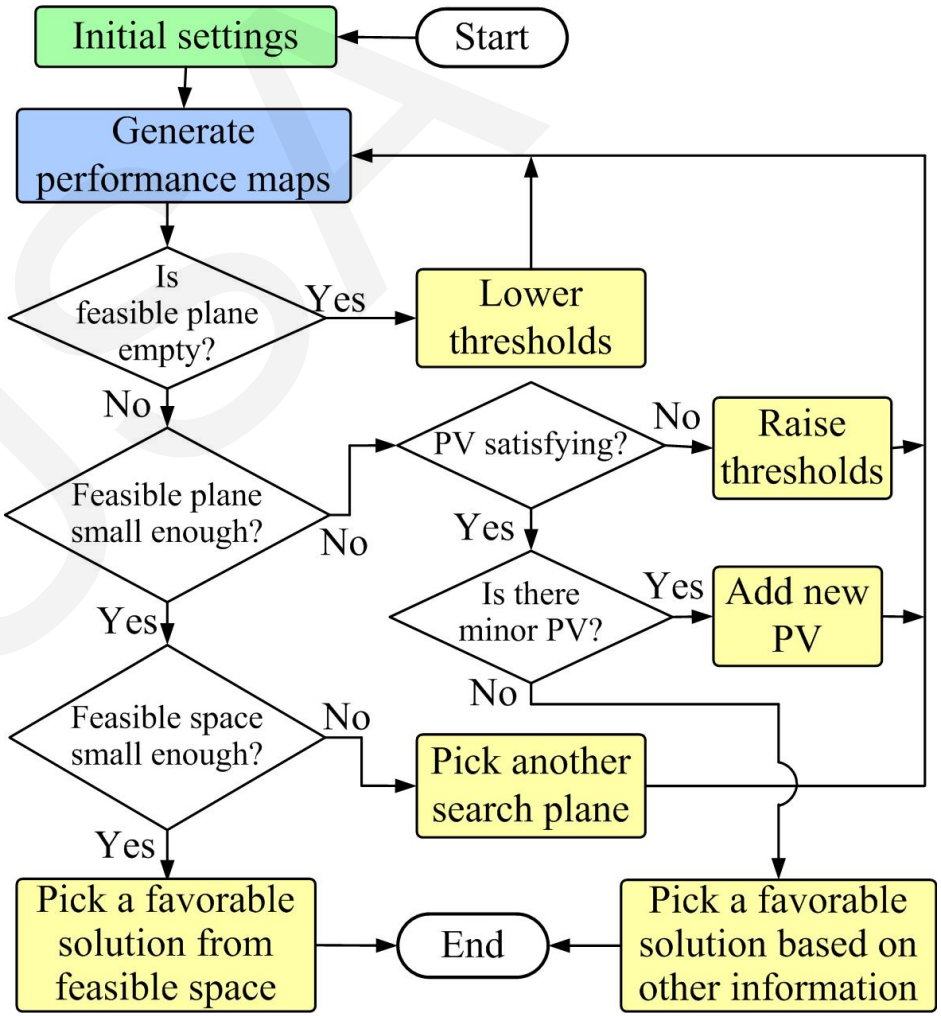


The feasible space tightening method

Performance information as well as feasible space projection on a two-dimensional design plane (named **the performance map**) can be derived with the help of MOEA algorithms, and used for interactive decision making.



The performance map



The decision flow

Summery

- The novel method demonstrated advantages in:
  1. Good distribution of Pareto solutions.
  2. Ability to solve high dimensional design problems.
  3. Intuitive visualization of PV-DV space.
  4. designer friendly of decision flow.
- The novel method is used to optimize a spring-pressurized reservoir step by step for a hydraulic actuated exoskeleton, and a satisfying design is presented.
- The reservoir shows reliable pressurization by experiment.