

# ON THE APPLICABILITY OF EXACT OPTIMIZATION IN SEARCH BASED SOFTWARE ENGINEERING

**Fabrcio Gomes de Freitas**, Thiago Nepomuceno da Silva, Rafael Ferreira do Carmo, Jerffeson Teixeira de Souza

{fabriciogf.uece@gmail.com, thi.nepo@gmail.com, carmorrafael@gmail.com, jeff@larces.uece.br}

Optimization in Software Engineering Group (GOES.UECE), State University of Cear (UECE) - Brazil

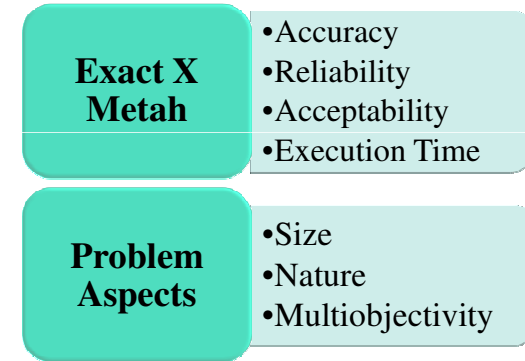
## ABSTRACT

The Search Based Software Engineering (SBSE) field has emerged as an exciting and promising area by proposing the formulation of **software engineering problems as optimization problems**. **Hitherto, metaheuristics** have been widely employed for solving these problems, whilst, **little or no considerable work** has been done regarding the use of **exact techniques** in the area. This paper aims to fulfil this lack by presenting a comprehensive study on the **theory and practice of the application of exact optimization in SBSE**. A **conceptual comparison** of both **optimization approaches** in the software engineering context is presented. **Problems' aspects** are analysed **regarding suitability** for use of exact techniques. As illustration, **comparison experiments** with exact technique and metaheuristics are conducted over a well-known SBSE problem. The results reveal the overall behaviour of exact techniques, regarding **efficacy and efficiency**, in the SBSE context considered, indicating its **potential use**.

## RESEARCH QUESTIONS

- RQ1 { • Is exact optimization appropriate for SBSE problems?
- RQ2 { • How does the execution time of exact method impact on its applicability?
- RQ3 { • How does metaheuristics perform on the problems tackled?

## ASPECTS ON METHODS AND PROBLEMS



$$\text{MONRP}$$

$$\text{Max } \sum \text{importance}$$

$$\text{Min } \sum \text{cost}$$

- Applicable in medium instances;
- Exponential growth in time;
- MOCe1 had better performance.

| Instance | I1  | I2  | C1  | C2  | R1  | R2  | B1  | B2  |
|----------|-----|-----|-----|-----|-----|-----|-----|-----|
| Clients  | 100 | 100 | 200 | 400 | 100 | 100 | 200 | 200 |
| Reqs     | 100 | 200 | 100 | 100 | 200 | 400 | 400 | 800 |

| Time (sec.)      | I1    | I2     | C1    | C2    | R1     | R2      | B1      | B2      |
|------------------|-------|--------|-------|-------|--------|---------|---------|---------|
| Branch-and-Bound | 33.30 | 201.74 | 59.18 | 98.85 | 126.96 | 508.41  | 855.63  | 4282.85 |
| NSGA-II          | 52.40 | 167.88 | 53.27 | 52.49 | 168.60 | 1315.53 | 1327.34 | 5645.91 |
| MOCe1            | 41.75 | 130.69 | 41.94 | 41.60 | 130.72 | 1493.01 | 1459.33 | 4809.56 |

| Metric | Metaheuristic | I1            | I2            | C1            | C2            | R1            | R2            | B1            | B2            |
|--------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|
| HV     | NSGA-II       | <b>0.6486</b> | <b>0.6086</b> | 0.6236        | <b>0.6158</b> | 0.6164        | 0.5801        | 0.5798        | 0.5173        |
|        | MOCe1         | 0.6460        | 0.6071        | <b>0.6249</b> | 0.6137        | <b>0.6191</b> | <b>0.5895</b> | <b>0.5823</b> | <b>0.5222</b> |
| Δ      | NSGA-II       | 0.9213        | 0.8193        | 0.8647        | 0.8690        | 0.8448        | 0.7909        | 0.7862        | 0.8105        |
|        | MOCe1         | <b>0.5869</b> | <b>0.6347</b> | <b>0.6147</b> | <b>0.6353</b> | <b>0.6616</b> | <b>0.6856</b> | <b>0.6965</b> | <b>0.7875</b> |

