Multi-fidelity modelling and optimisation for long-term capacity planning: ten month PhD review

Graham Burgess

November 2024

In this document I outline ammendments to the initial draft, based on discussion on 22nd October, 2024 (not including all ammendments based on specific comments in feedback received by email). I also list some potential topics of conversation on 8th November, 2024.

1 Introduction

- Introduce the more general context of queueing models in long-term capacity planning, where the homeless care setting is one example.
- Introduce the distinction between long and short service times when discussing examples of long-term capacity planning

2 Literature Review

- include discussion of recent JOS paper on long-term bed modelling critical care hosptial units
- include more references in Section 2.2.1 (Overview of SO methods)
- introduce problem of SO in queueing settings: bad solutions have high variance and are therefore difficult to eliminate
- include GMIA extensions rapid GMIA and multi-fidelity GMIA
- include discussion of current literature on multi-fidelity Bayesian optimisation.

3 Models of multi fidelity

4 Deterministic optimisation with low-fidelity model

5 Discussion of uncertainty

- re-introduce distinction between long and short service times: with long service times we are more interested in input uncertainty, and with short service times we are more interested in stochastic uncertainty.

- expand upon ideas for how input uncertainty could be incorporated into a future MFSO algorithm.

6 Potential research contributions

- Expand upon and emphasize the focus on incorporating structure into a MFSO algorithm. Knowledge of this structure comes from the fact that we are dealing with queueing problems.

To discuss on 8th November, 2024:

- The proposed PhD problem is 'artificial' in the sense that in reality public-section decision makers usually have a small number of potential plans for serious consideration. Discuss the implications of this reality on the proposed PhD direction.
- The proposed next steps addres rather technical challenges. Discuss whether tackling these issues is sufficient for a PhD.
- Do we really need the $M_t/M/h_t$ model if typically servers are always busy (idle servers crop up in complexities which only a simulation could handle)
- How could we incorporate 'uncertainty over time' into the current DO formulation?