1 Conclusion

In this chapter some concluding remarks will be presented. In this thesis, we have demonstrated that Krotov's method efficiently realises the $|0\rangle \rightarrow |1\rangle$ evolution for various pulse lengths when supplying guess pulses close to π-pulses. It can also find non-trivial solutions for shorter pulse lengths, when an amplitude constraints is present. `krotov` also realises a $|0\rangle \rightarrow |2\rangle$ evolution for various pulse lengths. This proves that `krotov` has potential to be used for non-trivial systems.

Finally and most importantly, we have shown that `krotov` allows to find an optimal pulse solution that allows to control a coupled system composed by a qubit and a resonator, such that the qubit state is dynamically transferred to the resonator by the solution pulse. This procedure is the basis for encoding qubit quantum information into an error correcting code such as a cat code. As the method could realise the transfer for arbitrary qubit states, there is good reason to conclude that `krotov` has the potential to be a valid tool in realising QEC with cat codes. Even though finding the optimal solution is computationally heavy, the pulses only need to be found once in order to be used for encoding. Although many challenges are still unsolved, this proof of concept gives confidence for further research into using `krotov` for encoding pulse optimization.

1.1 Future work

As stated in the previous chapter, there are many ways to extend this work. Suggestions for future work are to:

- fix the unrealistic sample rate,
- include dissipation/noise,
- penalize undesired states,
- perform ensemble optimization for different phases of the coupling pulses
- implement a problem-specific system propagator using Cython[1] for speedup and
- find pulses for other bosonic codes.

To encourage the reproduction of these results and further research a link to the source code is given in **??**.

[1] More info: `https://krotov.readthedocs.io/en/latest/09_howto.html#how-to-maximize-numerical-efficiency`.