#### Component Based MMIX Simulator using Multiple Programming Paradigms

A dissertation submitted in partial fulfilment of the requirements for the MSc in Advanced Computing Technologies

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# Abstract

MMIX was first proposed by Donald E. Knuth in [4]

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#### References

- [1] Akka toolkit. <a href="http://akka.io/">http://akka.io/</a> >[Access 24 August 2015].
- [2] Knuth, D. The art of computer programming fascicle 1 mmix [e-book]. Stanford University: Addison Wesley Available through: Stanford University <a href="http://www-cs-faculty.stanford.edu/~uno/fasc1.ps.gz">http://www-cs-faculty.stanford.edu/~uno/fasc1.ps.gz</a>>[Access 7 April 2013].
- [3] Knuth, D. MMIXware A RISC Computer for the Third Millennium. Springer, 1990.
- [4] Knuth, D. The Art of Computer Programming, vol. 1-4a. 1st ed. Addison Wesley, 2011.
- [5] RUCKERT, M. Mmix quick reference card. <a href="http://mmix.cs.hm.edu/doc/mmix-refcard-a4.pdf">http://mmix.cs.hm.edu/doc/mmix-refcard-a4.pdf</a> >[Access 24 August 2015], 2012.

### Appendix A

### Source Code

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