COMPLIANCE WITH THE DATA PROTECTION ACT 1998

EPSRC Fellowship Peer Review

EPSRC Reference: EP/S00503X/1

Document Status: With Council

EPSRC Fellowship - Early Career

Applicant Details

Applicant	Dr Ohad Kammar	Organisation	University of Oxford

Title of Research Project

Type refinement through algebraic effects

Review Information

Response Due Date	18/05/2018	Reviewer Reference:	059327144

Quality

Primary criterion. Please comment on the degree of research excellence of the proposal, making reference to:

(1) The novelty, relationship to the context, and timeliness;

(2) The ambition, adventure, and transformative aspects identified;

(3) The appropriateness of the proposed methodology.

(For multi-disciplinary proposals please state which aspects of the proposal you feel qualified to assess)

Although not stated clearly in the proposal objective or summary, this proposal addresses the fundamental objective of putting statistical probabilistic

programming on a firm foundational mathematical theory underlying axiomatics, type-renements/invariants,

and assertions to validate the correctness of Bayesian inference algorithms directly in their source code

without recourse to sophisticated mathematical models.

As this objective is rather difficult to state in layman term it is boiled down to the following five objectives:

1. Develop the basic semantic theory of refinement types.

2. Investigate prospects for high-assurance intelligent systems.

3. Use refinement types to validate state-of-the-art Bayesian inference algorithms.

4.Integrate the developed theory to existing tools

such as F-star and LiquidHaskell.

5 Extend the theory with expressive logic- and type-structure.

This is very a ambitious research agenda and it has the potential for develop reasoning techniques

and models for probabilistic programming languages, affecting the

wider scientific and industrial community, especially the safety of code for autonomous systems, such as self-driving cars

and drones.

The proposed methodology is first an foremost mathematical and founded in theoretical computer science going back to seminal work by Hoare, but also experimental as the developed theories are proposed to be integrated into existing systems such af F* and LiquidHaskell, the dominant technologies in this area.

Importance

Secondary major criterion. Comment on the national importance of the research. How it:
(1) Contributes to/helps maintain the health of other disciplines, contributes to addressing key UK societal challenges and/or contributes to future UK economic success and development of emerging industry(s);
(2) Meets national needs by establishing/maintaining a unique world leading activity;
(3) Complements other UK research funded in the area, including any relationship to the EPSRC portfolio.

Developing ICT faster and more reliable is at the hart of UK and global societal challenges, as society relies more and more on software, especially the UK economy.
Thus contributing methods and tools with the potential for developing software faster and more reliable is of high importance.
As stated in the proposal "Programming language axiomatics and semantics are long-established strengths of the UK" and thus this project will contribute to
"opening new research avenues and establishing the UK as a hub exporting advanced reasoning and probabilistic programming technology".
Thus the proposed research will certainly help to maintain and further the UKs unique world leadership in this area and could lead to cheaper and more reliable software development.

Impact

Secondary criterion. Please comment on the pathway to impact identified for this work, particularly:
(1) How complete and realistic are the impacts identified for this work;
(2) The effectiveness of the activities identified to help realise these impacts, including the resources requested for this purpose;
(3) The relevance and appropriateness of any beneficiaries or collaborators.

The project is first an foremost an academic foundation project with direct impact on the training of the two RA involved and "traditional" academic impact through publications, workshops and internships planned. However, as the project already has attracted industrial interest, there may be potential for industrial impact even within the time span of the proposed 5 years of the project and certainly beyond through the developed software.
The activities identified in the project proposal seem effective and realistic.
The project is appropriate and relevant for the identified beneficiaries and collaborators.

Ability to Deliver

Secondary criterion. Please comment on the applicant's ability to deliver the proposed project, making reference to:
(1) Appropriateness of the track record of the applicant(s);
(2) Balance of skills of the project team, including academic partners.

Although relatively young, the PI already has an impressive track record in the area of the proposed research and must be considered a world leader.
Also the named RAs have impressive track recourds and the skills og the PI and RAs complement each other well.

Research Vision

Secondary criterion. Comment on the overall research vision and how the fellowship would enable the applicant to achieve their career aspirations.

If successful, the projects vision is that probabilistic programming will become a disruptive technology, freeing users from tedious, errorprone,
low-level fiddling with inference algorithms and thus free programmer resources to develop functionality faster and more reliable. This is one of computer sicence's grand challenges and if successful it would enable the PI to establish himself as a world leading scientist in this area.

Leadership Potential

Secondary criterion. Given the applicant's declared current career stage, please comment on their potential (and the expected timescale) for them becoming an international research leader.

As already mentioned, if successful it would enable the PI to establish himself as a world leading scientist in this area within the time frame of the project.

Resources and Management

Secondary criterion. Please comment on the effectiveness of the proposed planning and management and on whether the requested resources are appropriate and have been fully justified. Please comment explicitly on any equipment requested, or the viability of the arrangements described to access equipment needed for this project, and particularly on any university or third party contribution.

The plan seems plausible and the requested resources seems appropriate.

Proposal Assessment

Please comment on the extent to which this proposal meets each of the criteria laid out in the call document not already covered by your previous answers.

Nothing further to add

Overall Assessment

Please summarise your view of this proposal

I think this is an ambitious, but realistic project proposal which has the potential to move the state-of-the-art in the area of foundations for Statistical probabilistic programming well beyond today's level. It has potential for industrial impact and if successful, probabilistic programming may become a disruptive technology, changing practice in industry.

I have therefor no hesitations in giving this proposal my warmest recommendations.

My judgement is that:
1) This proposal is scientifically or technically flawed
2) This proposal does not meet one or more of the assessment criteria
3) This proposal meets all assessment criteria but with clear weaknesses
4) This is a good proposal that meets all assessment criteria but with minor weaknesses
5) This is a strong proposal that broadly meets all assessment criteria
6) This is a very strong proposal that fully meets all assessment criteria

My confidence level in assessing this is:

1	2	3	4	5	✔ 6

		✔
Low	Medium	High

Reviewer Expertise

Please indicate your areas of expertise that are relevant to your assessment. Take care not to reveal your identity to the applicant.

Programming language design and implementation. semantics, Type theory, concurrency theory. Industrial experience in programming technology.