Dear Editors-in-chief,

Firstly may we take the opportunity to thank you and your reviewers for taking the time to review our research and to provide their comments. It was gratefully received, and we have worked hard to evolve the second version of the paper to account for them as best as we could.

Below is a table of responses directly to each comment explaining how they were incorporated within the revised version. The primary changes made are:

1. Refactor of the structure to improve organisation and clarity.
2. Full re-evaluation of the paper, removal of redundant or unnecessary components and combined similar elements to make the paper more succinct and targeted on the contributions.
3. Broader considerations of related work, both in the existing work section and throughout the paper.
4. Improved mathematical definitions and worked examples to better represent how the algorithm functions.

We hope that this revised version meets the expectations of the reviewers comments, but any further comments or recommendations would be gratefully received.

Yours sincerely

Tom Scott.

**Comment responses:**

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| **Reviewer** | **Comment**  | **Adjustment** |
| Review\_1 | While some equations are included, the discussion of the belief model feels ad hoc with minimal formal structure. It seems to be more of an empirical piece of work, where the authors have applied logic tensor networks to a setting that appears to necessitate a graphical model. This is not to say the work is trivial; rather, it lacks a rigorous and principled approach to the semantics and framework. | There has been a detailed re-write of many components, including increased mathematical definition, expanded examples, and a more refined methodology of how the model is developed and employed.  |
| Review\_1 | There exists a substantial amount of related work discussing how belief states could be integrated with probabilistic programming and probabilistic relational modelling. For instance, consider research on relational affordances, Problog applied to dynamic contexts, and distributional clauses in robot tracking and MDPs, MLNs to event modelling etc. Given that these pieces of work receive only a brief mention in the paper, it is hard to ascertain what is new and what constitutes a principled contribution in the broader context.  | A section on probabilistic methods has been added to the existing work, which seeks to cover the points highlighted and introduce how the complexity of the task makes their application challenging.  |
| Review\_1 | Adequacy of the bibliography: No | The has been revised and updated. |
| Review\_1 | Introduction: background and motivation: Limited | This has been refined with a more explicit definition of the gap and motivation for the research.  |
| Review\_1 | Organization of the paper: Needs improvement | The paper has been restructured, with some superfluous components removed, and the overall architecture brought into an introduction, existing work, methodology, experimentation, discussion and conclusion structure.  |
| Review\_2 | What is "caution" in the context of Figure 3? | An explanation of caution has been outlined in the figure description. It has been intentionally abstracted from specific platform dynamics, but represents the frequency of which context based analysis of an object is completed. Low caution can be satisfied through frames where tracking the target object may be sufficient, where as high caution would expect analysis at every frame.  |
| Review\_2 | Brief examples would greatly help understand the otherwise abstract sections 5.1.2 and 5.1.3. | Worked examples for both have been developed and integrated into the sections.  |
| Review\_2 | Alg 1 is more of an example (which is appreciated), but the model building/updating also needs to be formalized in a general manner. | The process for building and optimisation has been formalised alongside the algorithmic example.  |
| Review\_2 | In the training phase, it is not clear where the labels for traversability come from. Their availability seems to contradict the | This has been clarified within the new data labels subsection  |
| Review\_2 | Does not consider two recent approaches to traversability:Neurosymbolic: "PhysORD: A Neuro-Symbolic Approach for Physics-infused Motion Prediction in Off-road Driving", Self-supervised: "V-STRONG: Visual Self-Supervised Traversability Learning for Off-road Navigation" | This has been integrated into existing work within the Neurosymbolic section and the end-end terrain classification  |
| Review\_2 |  The discussion of beliefs is not grounded in the standard Bayesian causal models of Pearl: "Causality: Models, Reasoning and Inference" | A section within existing work has been added and a integrated more deeply throughout the paper more broadly |
| Review\_2 | Does not consider the area of causal representation learning (and such techniques like Causal VAE): "Toward Causal Representation Learning" | This has been integrated into the existing work and has also used the concept of observation and intervention in outline of the concept of continual learning. |
| Review\_2 | Does not consider how multimodality interacts with interpretability and performance in neurosymbolic architectures: "Surveying neuro-symbolic approaches for reliable artificial intelligence of things" | An additional section has been highlighted in the existing work as limitations to the Neurosymbolic approach.  |
| Review\_2 | "symbolic information ensures that the evolution remains deterministic" - confusing? | Agreed, this has been removed as the original intent did not contribute to the sentence.  |
| Review\_2 | p3l17 "a world models" | Corrected |
| Review\_2 | p3l21 "vision based systems" -> "vision-based systems" | Corrected |
| Review\_2 | 2.2. neurosymbolic AI" -> "2.2. Neurosymbolic AI" | Corrected |
| Review\_2 | It is not clear that it is worth dedicating an entire section 3 to what is essentially a paragraph | This has been remove and split into the introduction and the methodology components.  |
| Review\_2 | p7l31: "The architecture at 2 shows" -> "The architecture in Figure 2 shows" | Corrected |
| Review\_2 | Fig 2 text is not readable. Fig 3 font size can also be increased without making the figure larger. | These images have been updated to be clearer. |
| Review\_2 | p11l21 "a-priori" -> "a priori" | Corrected |
| Review\_2 | (multiple places) "adaption" -> "adaptation | Corrected |
| Review\_3 | 1. Computational overhead The added complexity of maintaining symbolic representations alongside neural components may introduce computational inefficiencies, especially in real-time applications. Future work should explore optimization techniques to improve inference speed. If the authors have done/any other mechanism where this is handled, please add in the revised version. | A component has been added to the discussion section which considers the application of BeliefNet to a physical platform analysing some of the computational implications of doing so.  |
| Review\_3 | 2. Evaluation metrics and benchmarks The paper benchmarks BeliefNet against a Random Forest classifier and a graph embedding model. While these comparisons highlight strengths, further evaluations against state-of-the-art deep learning models (e.g., Transformers, Reinforcement Learning) would provide a more comprehensive performance assessment. Please add this in the revised version. | The data structures and nature of context based prediction makes direct comparison with a transformer based architecture challenging within the time-period of this revision, as it would require the development of a new pipeline and a finetuned model. It has also been explained how the baseline values within the experimentation represent the output of a SOTA model used within the traversability classification context.  |
| Review\_3 | 3. Practical deployment considerations Although the paper presents theoretical and experimental validation, real-world deployment scenarios remain unexplored. Testing BeliefNet in diverse and extreme environments with autonomous vehicles would solidify its applicability. | This was out of scope for the research in this phase but has been discussed in more detail in the discussion section.  |
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