Article

Title

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Abstract: The proposed work aims to provide a path planning solution that use data about sea and weather conditions to find the optimal path the links 2 positions.

Keywords: path planning; sea-state

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1. Introduction

In recent years, robotics has been optimizing the monitoring and exploration of maritime and coastal scenarios through the use of multiple and sophisticated autonomous systems. This category includes the Autonomous Underwater Vehicles (AUV), underwater robots capable of completing missions autonomously, and the Autonomous Surface Vehicles (ASV), vehicles that rotate on the surface of the water without a crew. The application fields are various: geological prospecting, oceanographic monitoring, military sector, etc. Maritime navigation is an essential aspect of the shipping industry. Path planning in a maritime scenario is the process of determining the optimal route a vessel can take from the point of departure to the destination.

The goal of this paper is to propose a new path planning method that uses a probability map to influence the final path according to the sea-weather conditions. The focus will be on discussing the various challenges that arise in this area and the proposed solutions to overcome them. The method will be compared to some state-of-the-art techniques too.

1.1. State-of-the-art

TODO

1.2. Our contribution

TODO

2. Method

TODO The Sum Product Algorithm (SPA) is a well-known technique in the field of probabilistic graphical models, used to efficiently calculate the marginal probabilities of variables in a factor graph. In recent years, researchers have applied the SPA to the problem of path planning in robotics and autonomous vehicles. The SPA can be used to compute the probability of a robot successfully reaching a destination, given the current state of the environment, such as the presence of obstacles or the position of other objects. This approach allows for more efficient and accurate path planning, as it takes into account the uncertainty inherent in real-world environments. By leveraging the power of probabilistic inference techniques like the SPA, researchers are making significant strides towards creating more robust and effective path planning systems for a wide range of applications. The probabilistic frame espoused in this work is grounded on FactorGraphs(FG) that represent a unified way of rephrasing di rected and undirected probabilistic graphical models in an easy- to- manipulate forward and backward communication propagation(signal inflow). Our work on FG in reduced normal form(FGrn) has further simplified the FG frame reducing the network to interconnections of single-input single-output(SISO) blocks and diverters. Probabability consistence can be fluently propagated for conclusion and literacy. Seminal work on FG can be set up in and; some details on the optimized executions of FGrn can be set up in.

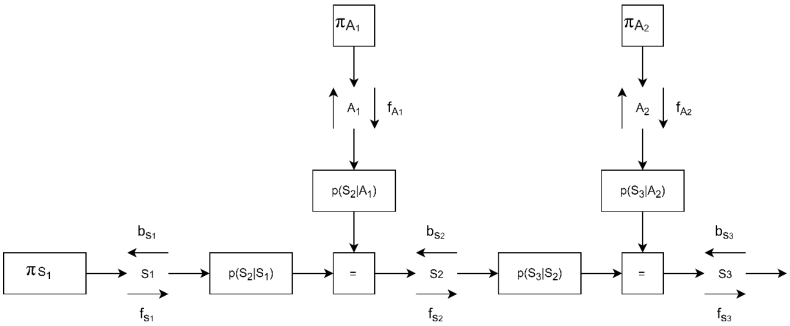

Figure 1. Factor graph in normal reduced form

$$\begin{aligned}
&f_{(S_tA_t)^1}(s_ta_t) = \textstyle\sum_{s_{t-1}a_{t-1}} p(s_ta_t|s_{t-1}a_{t-1})f_{(S_{t-1}A_{t-1})^3}(s_{t-1}a_{t-1});\\
&b_{(S_{t-1}A_{t-1})^3}(s_{t-1}a_{t-1}) \propto \textstyle\sum_{s_ta_t} p(s_ta_t|s_{t-1}a_{t-1})b_{(S_tA_t)^1}(s_ta_t);\\
&f_{(S_tA_t)^2}(s_ta_t) = c_t(s_ta_t);\\
&b_{(S_tA_t)^2}(s_ta_t) \propto b_{(S_tA_t)^3}(s_ta_t)f_{(S_tA_t)^1}(s_ta_t);\\
&b_{(S_tA_t)^1}(s_ta_t) \propto f_{(S_tA_t)^2}(s_ta_t)b_{(S_tA_t)^3}(s_ta_t);\\
&f_{(S_tA_t)^3}(s_ta_t) \propto f_{(S_tA_t)^1}(s_ta_t)f_{(S_tA_t)^2}(s_ta_t).
\end{aligned} \tag{1}$$

2.1. Input data

TODO The developed module takes as input several sets of data divided into:

- Data for the construction of the parameterized map: wave motion (significant height, direction, period, etc.), weather conditions (temperature, wind at 10 meters, marine pressure, rain, etc.);
- Mission data: mission objectives, Cobalt start and goal positions, drone release positions(Intermediate positions), mission duration, etc.;

2.2. Algorithm

TODO

2.3. Communication

TODO The communication between all the components of the DSS can comunicate through a MQTT broker. MQTT or Message Queue Telemetry Transport is a featherlight and effective message protocol developed for the Internet of effects(IoT). It allows bias to change data in a publish- subscribe model, where data is published by a sender and entered by one or further subscribers. The protocol is grounded on a customer- garçon armature where guests can publish or subscribe to motifs on a garçon(also known as a broker). MQTT is ideal for IoT bias because it consumes minimum bandwidth and has low above, making it able for low- authority and resource- constrained bias. Its simplicity, scalability, and trustability have made it popular with inventors and has come a standard-issue protocol in the IoT assiduity. An MQTT broker is a intermediary mecca that acts as a communication broker between MQTT guests. It's responsible for entering, storing, and ranking dispatches between guests. When an MQTT customer publishes a communication to a special content, the broker receives the communication and forwards it to all acceded guests that are interested in that content. also, when an MQTT customer subscribes to a content, the broker stores the subscription and forwards any dispatches published on that content to the acceded customer.

On the other phase, an MQTT customer is a device or operation that communicates with an MQTT broker. It can be either a publisher, subscriber, or both. When a customer publishes a communication to a special content, it sends the communication to the broker, which also on it to all acceded guests. When a customer subscribes to a content, it sends a subscription request to the broker, which stores the subscription and forwards any dispatches published on that content to the acceded customer.

In summary, the MQTT broker acts as an conciliator between MQTT guests, entering and ranking dispatches, while the MQTT guests are the bias or operations that give with the broker, publishing and assenting to dispatches. Together, the MQTT broker and guests form a publish- subscribe network, allowing effective and dependable message in IoT surroundings.

3. Results

TODO

4. Conclusions

TODO

Future developments:

- WGS84 coordinates-based algorithm (and/or projection with UTM);

5. Results

This section may be divided by subheadings. It should provide a concise and precise description of the experimental results, their interpretation as well as the experimental conclusions that can be drawn.

5.1. Subsection

5.1.1. Subsubsection

Bulleted lists look like this:

- First bullet;
- Second bullet;
- Third bullet.

Numbered lists can be added as follows:

1. First item;
2. Second item;
3. Third item.

The text continues here.

5.2. Figures, Tables and Schemes

All figures and tables should be cited in the main text as Figure 2, Table 1, etc.

Figure 2. This is a figure. Schemes follow the same formatting. If there are multiple panels, they should be listed as: (**a**) Description of what is contained in the first panel. (**b**) Description of what is contained in the second panel. Figures should be placed in the main text near to the first time they are cited. A caption on a single line should be centered.

Table 1. This is a table caption. Tables should be placed in the main text near to the first time they are cited.

Title 1	**Title 2**	**Title 3**
Entry 1	Data	Data
Entry 2	Data	Data [1]

[1] Tables may have a footer.

The text continues here (Figure 3 and Table 2).

Figure 3. This is a wide figure.

Table 2. This is a wide table.

Title 1	Title 2	Title 3	Title 4
Entry 1 *	Data Data Data	Data Data Data	Data Data Data
Entry 2	Data Data Data	Data Data Data	Data Data Data
Entry 3	Data Data Data	Data Data Data	Data Data Data
Entry 4	Data Data Data	Data Data Data	Data Data Data

* Tables may have a footer.

Text.
Text.

5.3. Formatting of Mathematical Components

This is the example 1 of equation:

$$a = 1, \tag{2}$$

the text following an equation need not be a new paragraph. Please punctuate equations as regular text.

This is the example 2 of equation:

$$a = b + c + d + e + f + g + h + i + j + k + l + m + n + o + p + q + r + s + t + u + v + w + x + y + z \tag{3}$$

Please punctuate equations as regular text. Theorem-type environments (including propositions, lemmas, corollaries etc.) can be formatted as follows:

Theorem 1. *Example text of a theorem.*

The text continues here. Proofs must be formatted as follows:

Proof of Theorem 1. Text of the proof. Note that the phrase "of Theorem 1" is optional if it is clear which theorem is being referred to. □

The text continues here.

6. Discussion

Authors should discuss the results and how they can be interpreted from the perspective of previous studies and of the working hypotheses. The findings and their implications should be discussed in the broadest context possible. Future research directions may also be highlighted.

7. Conclusions

This section is not mandatory, but can be added to the manuscript if the discussion is unusually long or complex.

8. Patents

This section is not mandatory, but may be added if there are patents resulting from the work reported in this manuscript.

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Acknowledgments: In this section you can acknowledge any support given which is not covered by the author contribution or funding sections. This may include administrative and technical support, or donations in kind (e.g., materials used for experiments).

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Abbreviations

The following abbreviations are used in this manuscript:

MDPI	Multidisciplinary Digital Publishing Institute
DOAJ	Directory of open access journals
TLA	Three letter acronym
LD	Linear dichroism

Appendix A

Appendix A.1

The appendix is an optional section that can contain details and data supplemental to the main text—for example, explanations of experimental details that would disrupt the flow of the main text but nonetheless remain crucial to understanding and reproducing the research shown; figures of replicates for experiments of which representative data are shown in the main text can be added here if brief, or as Supplementary Data. Mathematical proofs of results not central to the paper can be added as an appendix.

Table A1. This is a table caption.

Title 1	Title 2	Title 3
Entry 1	Data	Data
Entry 2	Data	Data

Appendix B

All appendix sections must be cited in the main text. In the appendices, Figures, Tables, etc. should be labeled, starting with "A"—e.g., Figure A1, Figure A2, etc.

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