An Extended Filter Design for Real Time Remote Tracking

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Abstract: ***In this thesis, we study the importance and the impact of simultaneous locating and mapping. Precisely, we are interested to study an Extended Filter Design for Remote Tracking Simultaneous Localization and Mapping (SLAM) is a key issue in robotics community. Simultaneous localization and mapping (SLAM) is a technique used by robots and autonomous vehicles to build up a map within an unknown environment (without a priori knowledge), or to update a map within a known environment (with a priori knowledge from a given map), while at the same time keeping track of their current location. Mapping is the problem of integrating the information gathered by a set of sensors into a consistent model and depicting that information as given in representation. This presents odometer based SLAM algorithm, making use of a novel artificial landmark which is called MR (Mobile Robot) code.***

Keywords: Localization, Mapping, Filter, Steering.

1. Introduction

Simultaneous localization and mapping (SLAM) is a technique used by robots and autonomous vehicles to build up a map within an unknown environment to update a map within a known environment while at the same time keeping track of their current location. Maps are used to determine a location within an environment and to depict an environment for planning and navigation they support the assessment of actual location by recording information obtained from a form of perception and comparing it to a current set of perceptions. The benefit of a map in aiding the assessment of a location increases as the precision and quality of the current perceptions decrease. Maps generally represent the state at the time that the map is drawn this is not necessarily consistent with the state of the environment at the time the map is used. Mapping is the problem of integrating the information gathered by a set of sensors into a consistent model and depicting that information as a given representation. It can be described by the first characteristic question. What does the world look like? Central aspects in mapping are the representation of the environment and the interpretation of sensor data. In contrast to this localization is the problem of estimating the place (and pose) of the robot relative to a map in other words the robot has to answer the second characteristic question, Where am I?

Typically, solutions comprise tracking, where the initial place of the robot is known and global localization in which it is just some a priori knowledge of the environmental characteristics of the starting position is given. The “solution” of the SLAM problem has been one of the notable successes of the robotics community over the past decade. SLAM has been formulated and solved as a theoretical problem in a number of different forms. SLAM has also been implemented in a number of different domains from indoor robots to outdoor, underwater, and airborne systems. At a theoretical and conceptual level, SLAM can now be considered a solved problem.

2. Literature Survey

In this we discuss the various notations and definitions required and followed with the survey of the project.

2.1 Environment Representation

Early work in SLAM assumed that the world could reasonably be modelled as a set of simple discrete landmarks described by geometric primitives such as points, lines or circles environment modelling depends both on the complexity of the environment and on the limitations of the sensing modality. Two common examples are sonar and vision. Sonar sensors typically produce accurate range measurements but often have large beam-width and side-lobes making the bearing estimate unusable [6]. Measurements from a single camera, on the other hand, provide bearing information without an accurate indication of range.

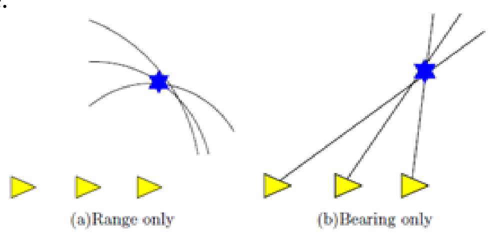

Figure 1: Partial observation. Some sensing modalities cannot directly observe a landmark location and require observations from multiple vantage points

SLAM with range-only sensors [9], [10] and bearing only sensors [8], [7] show that a single measurement is insufficient to constrain a landmark location. Rather it must be observed from multiple vantage points as shown in Figure 5[21].

2.2 Existing system

We presented an on-line mapping algorithm capable of differentiating static and dynamic parts of the environment even when the moving objects change position out of the field of the view of the robot. The algorithm could also uniquely classify each moving object and keep track of its location on the map. On the other hand, the approach is assumed ideal localization, a fairly narrow assumption.

2.3. Survey

The theoretical basis and a practical implementation of a computationally efficient solution to SLAM is presented in the paper shows that it is indeed possible to remove a large percentage of the landmarks from the map without making the map building process statistically inconsistent. Furthermore, it is shown that the efficiency of the SLAM can be maintained by judicious selection of landmarks, to be preserved in the map, based on their information content.

3. Design for Extended Filter

3.1. Software Design for extended filter

Software Design is the study of the structure and the organization of software development, the details of which were specified in the requirement specification. It is the process by which a set of requirements are transformed into a collection of data structures and algorithms that implement the requirements as one or more computer programs. The software design can be viewed as navigating a design space of high dimensionality, attempting to converge on the most economical/efficient solution for a given set of requirements.

3.2. Data Flow Diagram

A Data Flow Diagram (DFD) is a graphical representation of the "flow" of data through an information system. Data Flow models are used to show how data flows through a sequence of processing steps. The data is transformed at each step before moving on to the next stage. These processing steps or transformations are program functions when Data Flow diagrams are used to document a software design. The Data Flow Diagram (DFD) for the proposed Filter is given in the Figure 2

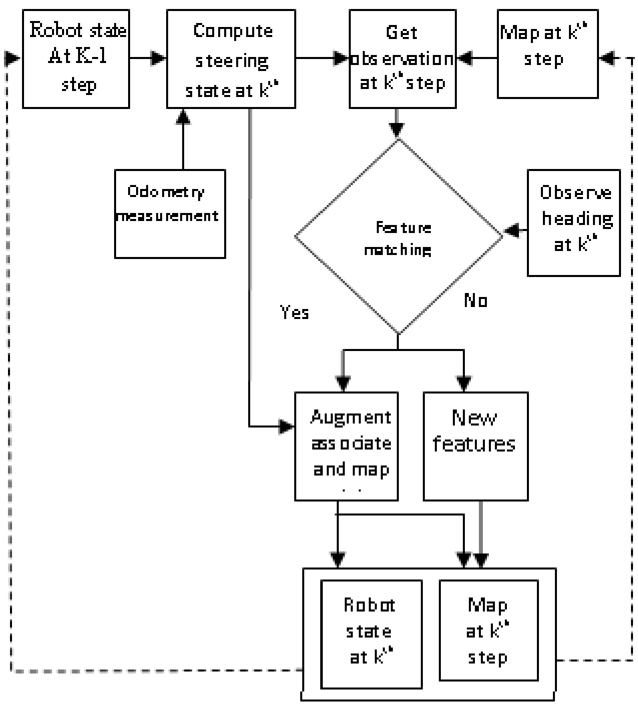

Figure 2: The Data Flow Diagram (DFD) for the proposed Filter.

3.3. Algorithm

This algorithm describes the procedure for constructing the proposed filter. This Design is actually based on the extended filter where the mapping is considered as the important criteria for Localization in SLAM. The Robot poses from the source to the destination point which passes through many paths. Here every Location has a neighbour list to check the distance to the next. This takes place using the consistent mapping which chooses the neighbour depending on the closeness to the destination. The formal algorithm for constructing this Design is given in Algorithm

Table 1: Algorithm

1. Robot starts in its own reference frame (all landmarks unknown)
2. Initialize 2N+3 dimensions
3. Update Robot motion in the plane to the 2N+3 dimensional space
4. The function g only affects the robot's motion and not the landmarks
5. Known data association
6. observes the landmark with index j
7. Initialize landmark if unobserved §
8. Compute the expected observation §
9. Compute the Jacobian of §
10. Then, proceed with computing the filter gain

3.4. Proposed system

We propose an on-line algorithm for simultaneous localization and mapping of dynamic environments. Our algorithm is capable of differentiating static and dynamic parts of the environment and representing them appropriately on the map. Our approach is based on maintaining two occupancy grids. One grid models the static parts of the environment, and the other models the dynamic parts of the environment. SLAM is based on alignment of sensor readings and detection of landmarks. Both techniques can fail in the presence of dynamic entities. The explicit identification of those dynamic entities can improve SLAM efficiency.

- To overcome some of the issues of discontinuous information we use an extended filter.
- Designing an extended filter which can strongly increase the state estimation precision and to decrease the error.
- It improves the localization precision and the map accuracy.
- It also enhances the credibility of the map.

Mapping of static environments has received considerable attention recently but in most cases, these algorithms cannot be directly applied to dynamic environments. Usually, the presence of moving objects leads these approaches to make mistakes and compromising the overall quality of the maps. This is a considerable problem since many realistic applications for robots are in non-static environments.

3.5. Applications of slam

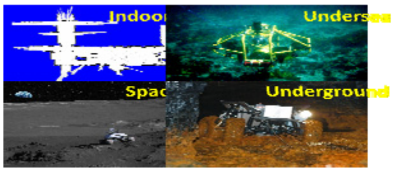

Figure 3: Slam in different applications

- Indoor
- Space
- Undersea
- Underground

3.6 .Object Tracking

Object tracking, in general, is a challenging problem. Difficulties in tracking objects can arise due to abrupt object motion, changing appearance patterns of the object and the scene, no rigid object structures, object-to-object and object-to-scene occlusions, and camera motion. Tracking is usually performed in the context of higher-level applications that require the location and/or shape of the object in every frame. Typically, assumptions are made to constrain the tracking problem in the context of a particular application. We categorize the tracking methods on the basis of the object and motion representations used, provide detailed descriptions of representative methods in each category, and examine their pros and cons.

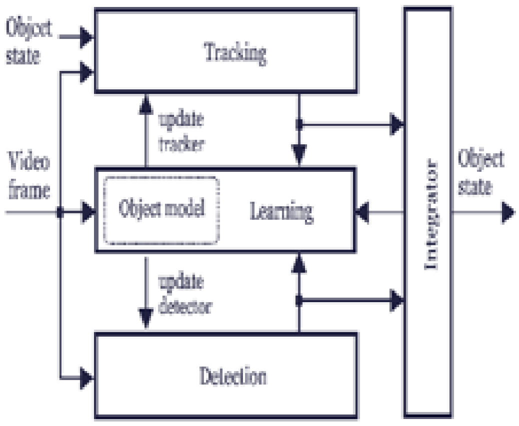

Figure 4: Simple block diagram of object tracking.

In its simplest form, tracking can be defined as the problem of estimating the trajectory of an object in the image plane as it moves around a scene. In other words, a tracker assigns consistent labels to the tracked objects in different frames of a video. Additionally, depending on the tracking domain, a tracker can also provide object-centric information, such as orientation, area, or shape of an object. Tracking objects can be complex due to:

- Loss of information caused by projection of the 3D world on a 2D image,
- Noise in images,
- Complex object motion,
- Non rigid or articulated nature of objects,
- Partial and full object occlusions,
- Complex object shapes,
- Scene illumination changes, and
- Real-time processing requirements.

3.7. Distortions in object tracking.

A change in the shape of an image is the result from imperfections of an optical system, such as a lens. In Electronics: An undesired change in the waveform of a signal. A distortion on a map is when you transfer information from a curved surface to a flat surface losing some accuracy. Distortion is a change in shape, size, or position of a place when it's shown on a map. . . . In example . . . Transferring information from a globe to a map =)...grace rocks. Scanning electron microscope image acquisition leads to distortion of object shape when the object is moving sufficiently fast during acquisition. The algorithms used up to now are not optimized to this problem. In this work, modifications to existing algorithms are proposed which make these algorithms robust against these distortions and allow robust tracking of the objects.

4. System Design

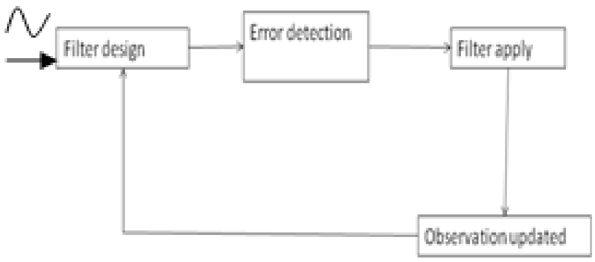

Figure 5: Block diagram of system

4.1. Detailed Design

4.1.1. Filter design

The process of designing a signal processing filter that satisfies a set of requirements, some of which are contradictory. The purpose is to find a realization of the filter that meets each of the requirements to a sufficient degree to make it useful. The filter design process can be described as an optimization problem where each requirement contributes with a term to an error function which should be minimized. Certain parts of the design process can be automated, but normally an experienced electrical engineer is needed to get a good result.

4.1.2. Error detection

The detection problem involves the use of suitable *sensors* for identifying the *error* occurred in an operation. In addition, the sensor signals are read by the related *intelligence* in order to classify the errors accurately.

4.1.3. Filter Apply

Filtering is different than sorting. When you sort items, you rearrange the current items in a view. For example, when you view the Inbox in single-line view, if you click the name Joanna Fuller and then click the from column header, all the messages in the Inbox will appear in alphabetical order with all the messages from Joanna Fuller at the top of your view. However, all the other messages are still viewable in the Inbox; they are now listed before and after Joanna Fuller in alphabetical order. If you scroll, you will see them all.

4.1.4 Observation update

Finally the map is updated as It shows the vehicle pose [x;y;phi], set of all landmarks, index tags for each landmark, maximum range of range-bearing sensor and represents as result with set of range-bearing observations, landmark index tag for each observation.

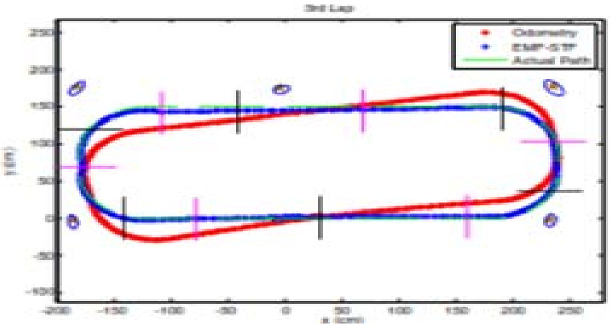

Figure 6: the robot path with estimated the landmark positions.

4.2.Simulation

Figure 7 shows how the robot starts from the source and ends at the destination and the estimate is shown.The vehicle performs two loops of the trajectory shown in Figure 7. The large decrease in uncertainty at 220 seconds is when the vehicle first closes the loop. It shows the result of the two runs. Notice that the covariance estimates of the standard EF are smaller than with ideal Jacobians. This indicates a significant level of information gain in the standard algorithm. The information gain in heading is shown in Figure 8. Where the top line shows the ideal Jacobian estimate and the lower line is the standard EF estimate. This result corroborates with the findings of Caste llanos. The heading uncertainty for the ideal Jacobians solution grows while ever the vehicle travels further into unmapped territory but, for the standard EF solution, the heading uncertainty reaches a ceiling and levels off.

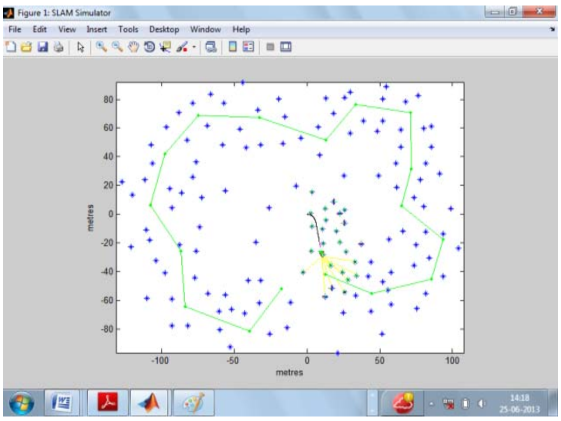

Figure 7: Jacobians linearised about the true state.

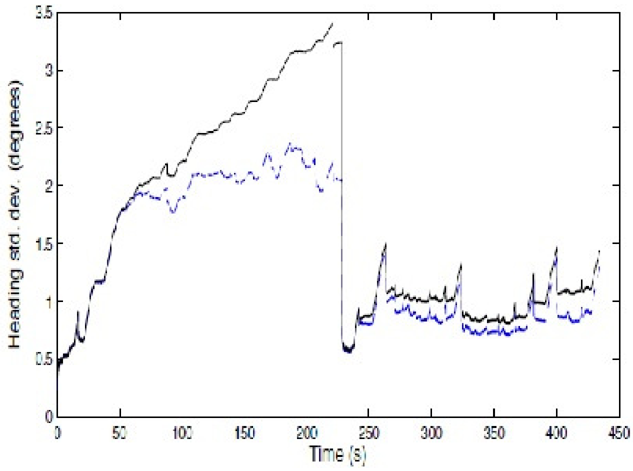

Figure 8: EF-SLAM heading to uncertainty.

5. Conclusion

In Simultaneous localization and mapping (SLAM), the inconsistency of the mapping is more. In this proposal we have developed the Extended Filter for Simultaneous Mapping and Localization architecture. This architecture provides accuracy and credible build maps compared to only SLAM architecture. This is because in our proposal we use the Filter where as the SLAM based architecture uses the without filter. The proposal not only reduces the Errors and in accuracy but also increases the Localization of the Robot. The simulation has been carried out and the results have been shown for the building consistency of the map for the robot movement.

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[23] Matthew C. Deans Martial Hebert , Carnegie Mellon University, hebert@ri.cmu.edu Invariant Filtering for Simultaneous Localization and Mapping

Author Profile

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