**SLAM Technology: Simultaneous/Synchronised Localization and Mapping Technology**

**Types of SLAM inputs:**

| Camera | Obtains visuals. |
| --- | --- |
| LiDAR | Light Detection and Ranging. Measures the object distance by emitting a laser to the object and capturing the travel time1. |
| Inertial | Inertial measurement units. Provides measurements of angular velocity and linear acceleration2. |
| mmWave | Wireless ecosystem connects 5G with large bandwidth and high frequencies. |

**Camera Sensor2:**

| **Pros** | **Cons** |
| --- | --- |
| Lots of data at low cost, light weight | Requires precise structure and motion to make estimations |
|  | Struggles to accurately capture estimations with dynamic motion |
|  | Requires decent object visibility and texture |

**LiDAR Sensor1:**

| **Pros** | **Cons** |
| --- | --- |
| Can get data from inaccessible places easily and accurately | Can be expensive |
| Can be combined with other sensors such as IMU's, GPS, Camera, Sonar etc. | Inefficient in rain and low-hanging weather. Difficulties penetrating dense material. |
| Used in both daytime and darkness | Analysing data can be time-consuming and resource intensive |
| Self contained hardware, can operate on its own | Stronger laser beams can be harmful to the naked eye |

**Inertial Sensor2:**

| **Pros** | **Cons** |
| --- | --- |
| Can provide robust and accurate motion estimations in combination with camera sensors. | Sensors need to be well calibrated, rigidly connected and precisely time-synchronised. |
| Can operate in less controlled, less visible/textured situations. |  |
| Can operate well with dynamic motion |  |

**mmWave Technology3:**

| **Pros** | **Cons** |
| --- | --- |
| Large bandwidth | High propagation loss, directivity and sensitivity to blockage |
| High frequencies |  |
|  |  |

**Slam and navigation of indoor robot based on ROS and lidar4**

* Looks like another student's research experiment using ROS and LiDAR.
* Doesn't seem that useful right now
* Lot's of calculations and formulas - could be useful to compare our own findings with theirs further down the track

**Comparison of Various SLAM Systems for Mobile Robot in an Indoor Environment5**

* Experiments and results of a range of SLAM systems on ROS
* Shows results for each type: pros, cons and consequences

**Utilizing ROS 1 and the Turtlebot3 in a Multi-Robot System6**

* Not sure how credible this is
* Just a starting point for understanding ROS
* Explains their findings on how and why ROS is suited for SLAM technology

**Existing research and uses for SLAM technology on indoor robots:**

* 2D Lidar-based SLAM and path planning for indoor rescue robots7
  + Well lit office/lab environments
  + Dark areas
  + Multilevel areas

# A Stereo Visual-Inertial SLAM Approach for Indoor Mobile Robots in Unknown Environments Without Occlusions

* + Another office space
  + Different approach
* What I've found so far:
  + Indoor office spaces (L-shapes, barriers, multilevel, well lit, dark spaces)
  + Outdoor (well lit, shady areas, rain)
* To look for:
  + Noisy areas (lots of devices and interference)
  + Smoke and foggy areas
  + Dynamic and changing areas (objects moving)

**Algorithms:**

**References:**

| 1 | <https://ieeexplore.ieee.org/abstract/document/9526266?casa_token=7QaP4-TFmOIAAAAA:5njxu8OvkNU3s2OMmWUqfvtKoAvvhVUsSqLW_nw2CtTzxWLUxzNuNsfW4ICpiORsa6Txogb-S0Q> |
| --- | --- |
| 2 | <https://ieeexplore.ieee.org/abstract/document/6906892?casa_token=yMwfp0WvC_8AAAAA:GDvOaBEbSKwbTMDmf7wYfiRvAGunHWrYCxxr-8VSjH6WWaWdgY2g8vlAs96GrxtnJsViRPaeCSQ> |
| 3 | <https://link.springer.com/article/10.1007/s11276-015-0942-z> |
| 4 | <https://iopscience.iop.org/article/10.1088/1742-6596/1748/2/022038/pdf> |
| 5 | <https://ieeexplore.ieee.org/abstract/document/8710464?casa_token=UiiUI-mCLq8AAAAA:4XcQnI0UnI1-2vow82Mg1kjtLZw32dlpxOPCWjXbTO5zCqGbEAbwwosF7-Yvc-mWQrIbdSeoIhA> |
| 6 | <https://arxiv.org/pdf/2011.10488.pdf> |
| 7 | <https://www.hindawi.com/journals/jat/2020/8867937/> |
| 8 | <https://ieeexplore.ieee.org/abstract/document/8937551> |

<https://dl.acm.org/doi/abs/10.1145/3386901.3388945>

| **Key:** |  |
| --- | --- |
|  | Helpful & credible |
|  | Helpful & credible but maybe not relevant |
|  | Lacking high quality or not credible |

**Want to know more about:**

* ROS
* 2D vs 3D LiDAR
* Indoor vs Outdoor Environment
* Different use cases/experiments with SLAM

**NEW**

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1. <https://www.usfa.fema.gov/data/>
2. <https://www.usfa.fema.gov/downloads/pdf/publications/firefighter-fatalities-2019.pdf>
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4. <https://ieeexplore-ieee-org.ezproxy.auckland.ac.nz/stamp/stamp.jsp?tp=&arnumber=8452260>
5. <https://ieeexplore.ieee.org/abstract/document/9440989>
6. <https://arxiv.org/pdf/2006.12567.pdf>
7. <https://dl.acm.org/doi/abs/10.1145/3450268.3453532>
8. <https://arxiv.org/abs/2112.05593> ?
9. <https://www.sciencedirect.com/science/article/abs/pii/S0921889012001777>
10. <https://en.wikipedia.org/wiki/Simultaneous_localization_and_mapping#cite_note-magnabosco13slam-8>
11. <https://ieeexplore.ieee.org/abstract/document/7973574>

**Groups of robots:**

* <https://ieeexplore-ieee-org.ezproxy.auckland.ac.nz/stamp/stamp.jsp?tp=&arnumber=8468281>