GSLAM: A General SLAM Framework and Benchmark

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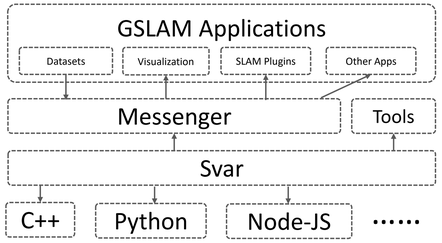
Architecture of GSLAM

GSLAM is aimed to provide an universal, cross-platform and full open-source SLAM platform for both research & commercial usages, which is beyond that of previous benchmarks. The SLAM interface is consisted by several lightweight, dependency-free headers, which makes it easy to interact with different datasets, SLAM algorithms and applications with plugin forms in an unified framework.



The framework of GSLAM

Svar: A Tiny Modern C++ Header Brings Unified Interface for Different Languages

```
Svar null=nullptr;
Svar b=false;
Svar i=1;
Svar d=2.1;
Svar s="hello world";
Svar v={1,2,3}
Svar m={"b",false,"s","hello world"}

Svar obj;
obj["m"]=m;
obj["pi"]=3.14159;

std::cout<<obj;

std::stringstream sst("[2,3,4]");
sst>>obj;
std::cout<<obj;

// use string literal
Svar lit="[false,3]"_svar;

if(s.is<std::string>()) // use is to check type
    std::cout<<"raw string is "<<s.as<std::string>(); // use as to force cast

double d=i.castAs<double>();// use castAs, this may throw SvarException
```

Demo of use Svar like JSON

Svar is the interface core of GSLAM with the following features:

- A superset of JSON, a thread-safe C++ container for everything including variables, functions, and classes;
- Argument parsing with auto completion and configure file loading;
- Auto expose interface for different languages with API documentation;

Messenger: A Tiny Class Implemented ROS Like Pub/Sub Messaging.

Messenger is the communication core of GSLAM with the following features:

- Header only based on c++11, no extra dependency, makes it portable.
- Thread safe and support multi-thread condition notify mode by setting the queue size.
- Able to transfer any classes efficiently, including ROS defined messages, which means it can replace ROS messaging or work with it.

	Messenger	ROS
Payload	C++ Objects/JSON + Buffer	Defined Messages
(De)Serialization	JSON/CBOR	ROS/ Protobuf
Platforms	Anywhere with C++11	Ubuntu(Before 2.0)
Delay	No Delay	Depends
Multi-Languages	✔	✔
Network	✔(NSQ Plugin)	✔(Built-in)

Compare between Messenger and ROS Messaging

Development of a SLAM Plugin with GSLAM

GSLAM unifies input & output for SLAM plugins, and provides some tools for SLAM development and evaluation.

Datasets

It is very easy to implement a dataset plugin based on the header-only GSLAM core and publish it as a plugin or compile it along with the applications. Users able to run a SLAM on different datasets with only one parameter modified.

Table 4: Dataset plugins build-in implemented until now.

Dataset	Year	Environment	Type
KITTI [29]	2012	outdoors	multi-cam, imu
TUMRGBD [63]	2012	indoors	RGBD
ICL [32]	2014	simulation	RGBD
TUMMono [18]	2016	indoors	mono
Euroc [9]	2016	indoors	stereo, imu
NPUDroneMap [8]	2016	aerial	mono
TUMVI [60]	2018	in/outdoors	stereo, imu
CVMono [5]	-	-	mono
ROS [57]	-	-	-

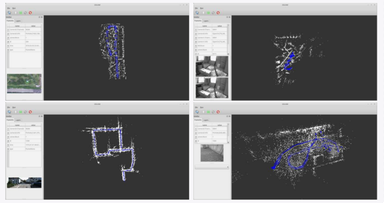
Implementation		Ours	DBoW2	DBoW3	FBoW
Load	*ORB-4*	**67.3us**	47.2ms	7.1ms	72.3us
	ORB-6	**7.2ms**	6.8 s	1.1 s	9.5ms
	SIFT-4	**1.0ms**	436.1ms	5.1ms	1.1ms
Save	*ORB-4*	**437.9us**	40.4ms	1.7ms	553.1us
	ORB-6	34.4ms	4.8 s	632.4ms	**20.6ms**
	SIFT-4	4.4ms	437.6ms	6.7ms	**2.7ms**
Train	*ORB-4*	**7.6 s**	24.8 s	23.6 s	8.5 s
	ORB-6	**230.5 s**	1.1Ks	911.4 s	270.4 s
	SIFT-4	23.5 s	327.7 s	299.0 s	**18.7 s**
Trans	*ORB-4*	**615.5us**	2.1ms	1.9ms	862.4us
	ORB-6	**723.7us**	6.0ms	4.9ms	1.2ms
	SIFT-4	**1.1ms**	10.3ms	9.2ms	11.5ms
Mem	*ORB-4*	**0.44MB**	2.5MB	2.5MB	0.45MB
	ORB-6	**44.4MB**	247.1MB	246.5MB	45.3MB
	SIFT-4	**5.8MB**	7.8MB	7.8MB	5.8MB

Tools

For making things easier to implement a SLAM plugin, GSLAM provides some utility classes such as Estimator, Optimizer and Vocabulary.

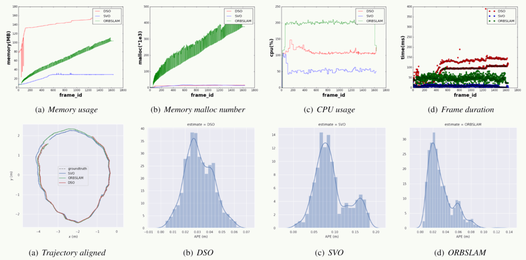
Visualization

GSLAM implemented plugin 'qviz' , which is a highly customizable visualizer based on Qt. Benefit from Svar solving dynamic objects, the qviz of GSLAM is more easier to use, more light-weighted and ready for extend.



Evaluation

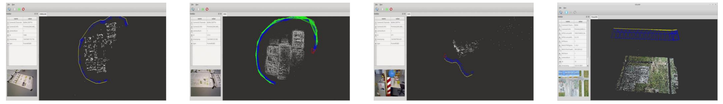
GSLAM provides some build-in plugins and script tools for both computation performance and accuracy evaluation.



Deployment of a SLAM Implementation Based on GSLAM

Once a SLAM plugin implemented based on GSLAM, it can be deployed to different applications without change anything.

Open Source SLAM Plugins Implemented

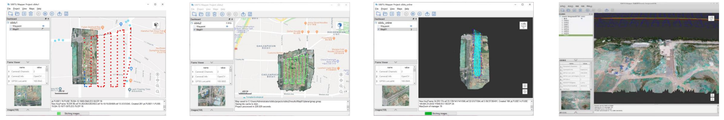


gslam_orbslam gslam_dso gslam_svo gslam_theia

Sibitu: A Commercial Arial Mapping Software Based on GSLAM

Sibitu is a software to perform 2D&3D mapping in real-time using SLAM technical, users can also stitching images offline with this software in SfM mode.
GSLAM is the core library used by SibituSDK to decouple different algorithms.

Website: http://www.sibitu.cn
Related projects:
https://github.com/zdzhaoyong/Map2DFusion
https://github.com/shaxikai/TerrainFusion



Online DOM Offline DOM Online DSM Offline DSM

Now Use GSLAM to Accelerate Your Research and Development !

Header only
Very light weighted ~ 20k lines
Easy to use
No dependency
Auto completion
Self documentation
Modern C++(11 standard)
Auto multi-language support

Source Code : https://github.com/zdzhaoyong/GSLAM
Related Codes: https://github.com/pi-gslam

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