Shiyu Song

CONTACT INFORMATION

Autonomous Driving Technology Department (ADT-US)
Employer: Baidu USA LLC
Personal Website: https://songshiyu01.github.io/ E-mail: shiyusong85@gmail.com
Immigration Status: U.S. Lawful Permanent Resident (EB1-B Green Card)

SUMMARY

I am one of the founding team members of the Baidu Autonomous Driving Car project. I joined Baidu in 2014. I am the principal scientist in Baidu Autonomous Driving Technology Department (ADT) now. Since Jan. 2016, I am the technical lead of the mapping and localization team of Baidu ADT. Prior to joining Baidu, I was a research scientist in the media analysis group in NEC Labs America, Cupertino, CA USA.

RESEARCH INTERESTS

Computer Vision, Machine Learning, Deep Learning, Simultaneous Localization and Mapping (SLAM)

EDUCATION

University of California, San Diego, La Jolla, CA USA

Ph.D. Sep. 2008 – Jun. 2014

- Area of Study: Computer Engineering

Tsinghua University, Beijing, P.R. China

B.S. Sep. 2004 - Jul. 2008

- Area of Study: Eletrical Engineering

WORK EXPERIENCE

Baidu ADT-US, Sunnyvale, CA USA

Principal Scientist/Tech Lead (T9) **Mar. 2018 – Present**

Lead a team across China and the U.S. to build state-of-the-art mapping and localization technologies for level 4/5 self-driving cars. Provide map service to global Apollo partners and developers, and internal users. Support daily map updates to fight off the challenges in dynamically changing urban scenarios. Built a multi-sensor (LiDAR, GNSS RTK, Camera, IMU, Wheel Encoder, et al.) fusion-based localization system that supports the stable operation of a large autonomous driving fleet in both the U.S. and China.
Since Jan. 2020, I initiated and lead two exploratory pilot projects in Baidu ADT US: 1) pedestrian motion prediction; 2) Imitation/reinforcement learning based decision and planning.

Staff Research Scientist/Tech Lead (T8) **Sep. 2016 – Feb. 2018**

Lead the HD map production upgrade targeting for mass production and the development of the multi-sensor fusion based localization system, achieving 5-10cm RMS accuracy. They are deployed in a large autonomous driving fleet, made our vehicles fully autonomous in crowded city streets. Support the development of the open-source Apollo platform and the L4 minibus pilot - Apolong.

Senior Research Scientist/Tech Lead (T7) **Jan. 2016 – Sep. 2016**

Lead the development of HD map and LiDAR/GNSS-based localization system. Successfully supported Baidu's autonomous driving fleet and their first public demo in the 3rd World Internet Conference in Wuzhen, China.

Baidu IDL-US, Sunnyvale, CA USA

Research Scientist (T6) **Nov. 2014 – Dec. 2015**

Built the first generation of the high-definition (HD) map production pipeline, LiDAR-based localization system, and LiDAR calibration toolkit. They successfully supported Baidu's very first 28km autonomous driving demo at the G7 and 5-ring road in Beijing, 2015.

NEC Laboratories America, Cupertino, CA USA

Research Scientist **Jan. 2014 – Oct. 2014**

Built a real-time monocular visual odometry system that corrects for scale drift for autonomous driving. Vision-based object detection, 3D bounding box estimation and lane detection were integrated to establish a complete visual perception system.

NEC Laboratories America, Cupertino, CA USA

Research Intern **Apr. 2012 – Dec. 2013**

Built a real-time monocular visual odometry system for autonomous driving.

University of California, San Diego, La Jolla, CA USA

Research Assistant **Jun. 2009 – Jan. 2011**

Multi-sensor comparison and data fusion for mapping enclosed spaces.

Honours and Awards

The 20th China Patent Award - Silver Award, China National Intellectual Property Administration (CNIPA), Shiyu Song, Wenbo Li, Tianlei Zhang, Patent: ZL201610348334.7, China, 2018

Baidu President's Special $1,000,000 Award, Finalist, Low-cost Localization System for Autonomous Driving, Baidu, 2018

Baidu President's Special $1,000,000 Award, Finalist, Multi-sensor Fusion based Localization System for Autonomous Driving, Baidu, 2017

Best Team, Apollo Platform, Baidu, 2017

Best Team, Autonomous Driving Exploration Tour at Wuzhen, Baidu, 2016

Employee of the Quarter, Institute of Deep Learning (US), Baidu, Q3 2015

Spot Recognition Award, "Real-Time Monocular SFM for Autonomous Driving", Department of Media Analytics, NEC Laboratories America, 2012

Selected Presentations

Technical Tutorial "Inside Apollo: Multi-sensor Fusion Based Localization" in Proceedings of Computer Vision and Pattern Recognition (**CVPR**) 2019.

Invited Speech "Towards Learning-based Localization for Autonomous Driving" in Proceedings of Innovation Forums, Multimedia Information Processing and Retrieval (**MIPR**) 2019.

Invited Speech "Localization and HD Map at Baidu IDG" in Proceedings of Baidu AI Developer Conference 2018.

Invited Speech at the Laser Scanning Workshop in conjunction with the ISPRS Geospatial Week 2017.

Oral Presentation in Proceedings of Computer Vision and Pattern Recognition (**CVPR**) 2015.

Selected Publications

Yao Zhou, Guowei Wan, Shenhua Hou, Li Yu, Gang Wang, Xiaofei Rui, **Shiyu Song**, "DA4AD: End-to-End Deep Attention-based Visual Localization for Autonomous Driving", *in Proceedings of European Conference on Computer Vision (**ECCV**)*, 2020. Acceptance Rate: 27%.

Wendong Ding, Shenhua Hou, Hang Gao, Guowei Wan, **Shiyu Song**, "LiDAR Inertial Odometry Aided Robust LiDAR Localization System in Changing City Scenes", *in Proceedings of Robotics and Automation (**ICRA**), 2020 IEEE International Conference on*, May 31 - June 4, Paris, France. Acceptance Rate: 42%.

Weixin Lu, Guowei Wan, Yao Zhou, Xiangyu Fu, Pengfei Yuan, **Shiyu Song**, "DeepVCP: An End-to-End Deep Neural Network for Point Cloud Registration", *in Proceedings of the IEEE International Conference on Computer Vision (**ICCV**)*, 2019. Acceptance Rate: 25%.

Weixin Lu, Yao Zhou, Guowei Wan, Shenhua Hou, **Shiyu Song**, "L3-Net: Towards Learning based LiDAR Localization for Autonomous Driving", *in Proceedings of Computer Vision and Pattern Recognition (**CVPR**), 2019 IEEE International Conference on*, June 16 -20, Long Beach, CA. Acceptance Rate: 25.2%.

Guowei Wan, Xiaolong Yang, Renlan Cai, Hao Li, Hao Wang, **Shiyu Song**, "Robust and Precise Vehicle Localization based on Multi-sensor Fusion in Diverse City Scenes", *in Proceedings of Robotics and Automation (**ICRA**), 2018 IEEE International Conference on*, May 21-25, Brisbane, Australia. Acceptance Rate: 40.6%.

Shiyu Song, Manmohan Chandraker and Clark C. Guest, "High Accuracy Monocular SFM and Scale Correction for Autonomous Driving" in *Pattern Analysis and Machine Intelligence (**PAMI**), IEEE Transactions on*, pages 730 - 743, April 1 2016, doi: 10.1109/TPAMI.2015.2469274.

Shiyu Song, Manmohan Chandraker, "High Accuracy 3D Object Localization with Joint SFM and Detection Cues" *in Proceedings of Computer Vision and Pattern Recognition (**CVPR**), 2015 IEEE International Conference on*, June 8-10 2015, Boston, Massachusetts (**Oral presentation**, Acceptance Rate: 3.3%).

Shiyu Song, Manmohan Chandraker, "Robust Scale Estimation in Real-Time Monocular SFM for Autonomous Driving", *in Proceedings of Computer Vision and Pattern Recognition (**CVPR**), 2014 IEEE International Conference on*, June 24-27 2014, Columbus, Ohio. Acceptance Rate: 29%.

Shiyu Song, Manmohan Chandraker and Clark C. Guest, "Parallel, Real-time Monocular Visual Odometry", *in Proceedings of Robotics and Automation (**ICRA**), 2013 IEEE International Conference on*, pp 4698 - 4705, May 6-10 2013, Karlsruhe. Acceptance Rate: 39%.

Selected Patents

Guowei Wan, Hao Li, Yao Zhou, **Shiyu Song**, Fangfang Dong, "Laser point cloud positioning method and system", United States Patent Application 16/168,179, filed on 2019/05/16, Assignee: Baidu USA LLC

Xiaolong Yang, Renlan Cai, **Shiyu Song**, Fangfang Dong, "Integrated positioning method and system", United States Patent Application 16/179,460, filed on 2019/05/16, Assignee: Baidu USA LLC

Li Yu, Shichun Yi, **Shiyu Song**, Fangfang Dong, Baoqiang Xu, "Method and apparatus for constructing reflectance map", United States Patent Application 15/800,260, filed on 2019/02/21, Assignee: Baidu USA LLC

Weilin Peng, Li Yu, Shengpan Xu, Hailong Tian, **Shiyu Song**, Fangfang Dong, "Method and device for generating position information of target object", United States Patent Application 15/784,908, filed on 2019/01/24, Assignee: Baidu USA LLC

Shichun Yi, Cheng Wang, Li Yu, **Shiyu Song**, Fangfang Dong, "Method, apparatus and terminal device for constructing map", United States Patent Application 15/724,945, filed on 2019/01/24, Assignee: Baidu USA LLC

Feilong Yan, He Yan, Liang Wang, Bosheng Wang, **Shiyu Song**, Weixin Lu, "Method and apparatus for identifying laser point cloud data of autonomous vehicle", United States Patent Application 16/026,338, filed on 2019/01/10, Assignee: Baidu USA LLC

Li Yu, Cheng Wang, **Shiyu Song**, Fangfang Dong, "Method and Apparatus for Acquiring Information", United States Patent Application 15/891,184, filed on 2018/11/29, Assignee: Baidu USA LLC

Guowei Wan, Hao Wang, **Shiyu Song**, Baoqiang Xu, "Method and apparatus for positioning vehicle", United States Patent Application 15/882,131, filed on 2018/10/25, Assignee: Baidu USA LLC

Shichun Yi, Cheng Wang, Li Yu, **Shiyu Song**, Baoqiang Xu, "Method and apparatus for updating maps", United States Patent Application 15/876,032, filed on 2018/10/18, Assignee: Baidu USA LLC

Renlan Cai, Xiaolong Yang, Guowei Wan, Weixin Lu, **Shiyu Song**, Baoqiang Xu, "Method and apparatus for positioning vehicle", United States Patent Application 15/876,008, filed on 2018/10/18, Assignee: Baidu USA LLC

Shiyu Song, Wenbo Li, Tianlei Zhang, "Driverless Vehicle, Method, Apparatus and System for Positioning Driverless Vehicle", United States Patent Application 15/283,018, filed on 09/30/2016, Assignee: Baidu USA LLC

Shiyu Song, Wenbo Li, Tianlei Zhang, "Unmanned Vehicle, Method, Apparatus and System for Positioning Unmanned Vehicle", United States Patent Application 15/282,984, filed on 09/30/2016, Assignee: Baidu USA LLC

Shiyu Song, Manmohan Chandraker, "High Accuracy Monocular Moving Object Localization", United States Patent # 9,367,922, grant on 06/14/2016, Assignee: NEC Labs America.

Shiyu Song, Manmohan Chandraker, "Robust Scale Estimation in Real-time Monocular SFM for Autonomous Driving", United States Patent # 9,189,689, grant on 11/17/2015, Assignee: NEC Labs America.

Shiyu Song, Manmohan Chandraker, Yuanqing Lin, Xiaoyu Wang, "Moving Object Localization in 3D Using a Single Camera", United States Patent # 9,070,202, grant on 06/31/2015, Assignee: NEC Labs America.

Shiyu Song, Manmohan Chandraker, "Real-time Monocular Visual Odometry", United States Patent # 9,148,650, grant on 09/29/2015, Assignee: NEC Labs America.

Professional Experience

Journal Paper Reviews: IEEE Transactions on Intelligent Transportation Systems, Computer Vision and Image Understanding, Image and Vision Computing, Pattern Recognition, Computational Applied Mathematics, IEEE Signal Processing Letters, IEEE Transactions on Multimedia.
Conference Reviews: IROS 2015, 3DV 2015, IROS 2016, CVPR 2016, CVPR 2017, ICCV 2017, CVPR 2018, ICRA 2018, CVPR 2019, ICCV 2019, BMVC 2019, CVPR 2020, ECCV 2020, IROS 2020.