Ruibin Ma

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Summary

Research Scientist in Meta Inc.
Doctor of Philosophy in Computer Science, University of North Carolina at Chapel Hill.
Bachelor of Engineering in Electronic Engineering, Tsinghua University.
Specialty: computer vision, 3D reconstruction, machine learning, medical image analysis

Education

- **University of North Carolina at Chapel Hill** — Chapel Hill, NC, USA
  Ph.D. of Computer Science — *Aug. 2016 – Jan. 2021*
  - **Dissertation**: Computer-aided Visualization of Colonoscopy (detailed later)
  - **Advisor**: Prof. Stephen M. Pizer and Prof. Jan-Michael Frahm
  - **Selected Courses**: Image Processing and Analysis; Computer Vision of Our 3D World; Optimal Estimation in Image Analysis; Visual Solid Shape; Operating System; Parallel Computing; Robotics
- **Tsinghua University** — Beijing, China
  Bachelor of Engineering in Electronic Engineering; GPA: 90.8/100 3.7/4.0 — *Aug. 2012 – July. 2016*
  - **Selected Courses**: Computer Program Design in C/C++; Data and Algorithms; Signal and System; Digital Signal Processing; Digital Image Processing; Probability and Stochastic Processes; Advanced Matlab Programming and Its Application; Image Compression
  - **Awards**: 2013 & 2015 “Zheng Geru” Scholarship for Academic Excellence ; 2015 “Tiao Zhan Bei” Science&Technology Competition 3rd Level Award; 2016 “Tang Yanying” Scholarship for Academic Excellence.

Work / Experience

- **Meta, Inc. (former Facebook, Inc.)** — Seattle, WA, USA
  Research Scientist — *Apr 2021 - present*
  - **Sparse 3D Reconstruction**: Research and productionisation of sparse 3D reconstruction algorithms such as Structure from Motion (SfM) and Simultaneous Localization and Mapping (SLAM). Retrieving 3D point cloud and camera position from multiple data sources including phone imagery, professional mapping backpack rigs/vehicles, and AR/VR headsets.
  - **Dense 3D Reconstruction**: Building dense 3D surfaces using depth image fusion (TSDF) and multi-view stereo (MVS) methods. Empowering VR headset users with the capability of mapping and reconstructing their own space. Enabling VR content creation and VR meeting experiences.
  - **AR/VR Relocalization**: Empowering AR/VR product (like Oculus Quest) users relocalization capabilities. Retrieving 6 degrees of freedom (DoF) camera positions by a fusion of visual matching, GPS, and LiDAR geometry matching technologies. Providing users with indoor/outdoor AR contents (artist creations, store information, etc.)
  - **Large Scale 3D Reconstruction Merging and Management**: Developing infrastructure to storing user-uploaded 3D reconstruction on the cloud. Developing algorithms to align different 3D reconstructions to together using visual/geometry matching technologies. Delivering large scale AR/VR experience.
- **University of North Carolina at Chapel Hill** — Chapel Hill, NC, USA
  Research Assistant, Dissertation Research — *Aug 2016 - Dec 2020*
  - **3D reconstruction of colonoscopy**: Reconstruct a colon surface from colonoscopy to visualize missing regions and provide surgical navigation. This project is based on SLAM technique and deep learning. Deep-learning-predicted depth maps are used to provide robust keyframe reference for a SLAM pipeline. The SLAM pipeline provides local bundle adjustment to optimize camera drift. This win-win strategy makes SLAM working on colon images which are very hard for standard SLAMs. By fusing the depth maps, we achieved real-time colonoscopy reconstruction.
  - **Generalized cylindrical surface deformation**: Solved a computer graphics problem of deforming a generalized cylindrical triangle mesh to a straightened one without unnecessay distortion. Incorporated shape analysis techniques (skeleton representation) with finite-element mesh deformation methods. Worked interdisciplinarily with a mathematician and several computer scientists. The program is implemented in C++ using Qt Creator and Visualization Toolkit(VTK).

- **Image retrieval in endoscopic videos**: This is a surgical navigation project to help a colonoscopist to determine the current position (progress) inside a human colon. Traditional methods like SIFT-based matching performs badly because colon images are extremely low-textured. A deep-learning-based method was developed to compute a global descriptor for each image which is a more robust representation.

- **Facebook** New York, NY (physically in Chapel Hill, NC), USA
  Software Engineer Intern *May - Aug 2020*
  - **Place Ranking**: Predict user's location at entity level based on mobile signals. I developed a multi-task multi-label neural network to leverage difference ground truth sources. The model was highly efficient and was suitable for deployment on device. It achieved better accuracy and lower CPU/memory cost than the production model. This is a hybrid project of Python and C++.

- **University of North Carolina at Chapel Hill** Chapel Hill, NC, USA
  Instructor *Jan - May 2020*
  - **COMP 776 - Computer Vision in Our 3D World**: I taught this graduate-level course which introduces 3D computer vision. It covers fundamental geometric concepts including mathematical representations of a camera, projective geometry for image formation, image transformations, robust estimation techniques, multiview geometry, and stereo depth estimation. It also covers Structure from Motion, Deep Learning and its application in Computer Vision. Course website: https://comp776s20.web.unc.edu.

- **Google** Palo Alto, CA, USA
  Software Engineer Intern, Google AI Healthcare *May - Aug 2019*
  - **Medical report (text) classification**: Pathology reports contain useful categorical information such as the main organ type, disease type, etc. These categorical information can be used for large-scale statistical analysis or serve as annotation for other modalities such as pathology slides (images). However, manual classification for a huge number of reports on multiple tasks are labor-intensive. In this project, I investigated a general-purpose NLP model called BERT on multilabel text classification. I validate it on five different multilabel classification tasks and achieve highed mean average precision). The system can save human labor by 80% to 98% depending on tasks with similar automatic classification accuracy as human.

- **Google** Mountain View, CA, USA
  Software Engineer Intern, Tools and Infrastructure, Ads *May - Aug 2018*
  - **Lint Error Repairer Based on Neural Machine Translation**: Based on the observation that programmers fix program errors following similar patterns, I implemented a pipeline for repairing lint errors using neural machine translation. A deep learning model for translation task is trained using code examples extracted from Google's (Python) code database. The model translates from problematic code to corrected code. Testing experiments has shown promising results.)
    I gave a presentation on Ads and Commerce Enginnering Productivity Forum in Google.

- **Brigham and Women's Hospital, Harvard Medical School** Boston, MA, USA
  Research Intern *Jul - Sep 2015*
  - **3D-Slicer module development**: Development of a module in 3D-Slicer (a medical image analysis platform) using Python. The module segments catheters in MRI images automatically for gynecologic brachytherapy. Contributed an iterative error detection and modification framework in that module. Collaborated paper published in *Medical Image Analysis.*

- **Tsinghua University** Beijing, China
  Undergraduate Thesis *Aug 2012 - Jul 2016*
  - **Bottle detection in videos of garbage**: Developed a program that can automatically detect recyclable bottles in a video of garbage in real time. The method is based on deep learning (Faster-RCNN).

Publications

- **R. Ma**, S. McGill, R. Wang, J. Rosenman, J. Frahm, Y. Zhang, and S. Pizer. Colon10K: A Benchmark for Place Recognition in Colonoscopy. In *IEEE International Symposium on Biomedical Imaging* (2021)

- **R. Ma** and R. Wang, S. Pizer, J. Rosenman, S. McGill, and J. Frahm. RNNSLAM: Reconstructing the 3D Colon to Visualize Missing Regions during a Colonoscopy. In *Medical Image Analysis - MICCAI 2019 Special Issue*

- **R. Ma** and R. Wang, S. Pizer, J. Rosenman, S. McGill, and J. Frahm. Real-time 3D reconstruction of colonoscopic surfaces for determining missing regions. In *Medical Image Computing and Computer Assisted Intervention (MICCAI)* (2019), Shenzhen, China. **Best Presentation Award**
- **R. Ma**, C. Chen, G. Li, W. Weng, A. Lin, K. Gadepalli, and Y. Cai. Human-centric Metric for Accelerating Pathology Reports Annotation. In *Neurips 2019 Workshop of Machine Learning for Health*, Vancouver, Canada.
- **R. Ma**, Q. Zhao, R. Wang, J. Damon, J. Rosenman, and S. Pizer. Deforming generalized cylinders without self-intersection by means of a parametric center curve. In *Computational Visual Media Journal* (2018) 4: 305.
- **R. Ma**, Q. Zhao, R. Wang, J. Damon, J. Rosenman, and S. Pizer. Skeleton-based generalized cylinder deformation under the relative curvature condition. In *Pacific Graphics* (2018), Hong Kong, China.
- Y. Zhang, S. Wang, **R. Ma**, S. McGill, J. Rosenman, and S. Pizer. Lighting Enhancement Aids Reconstruction of Colonoscopic Surfaces. In *Information Processing in Medical Imaging (IPMI)* (2021), Bornholm, Denmark.
- S. McGill, J. Rosenman, R. Wang, **R. Ma**, J. Frahm, S. Pizer. Artificial Intelligence Identifies and Quantifies Colonoscopy Blind Spots. *Endoscopy* (2021)
- S. Zhang, L. Zhao, S. Huang, **R. Ma**, B. Hu, Q. Hao. 3D Reconstruction of Deformable Colon Structures based on Preoperative Model and Deep Neural Network. In *IEEE International Conference on Robotics and Automation (ICRA)* (2021), Xi'an, China
- F. Chen, **R. Ma**, J. Liu, M. Zhu, and H. Liao. Lumen and media-adventitia border detection in IVUS images using texture enhanced deformable model. In *Computerized Medical Imaging and Graphics* (2018) 66.
- A. Mastmeyer, G. Pernelle, **R. Ma**, L. Barber, and T. Kapur. Accurate model-based segmentation of gynecologic brachytherapy catheter collections in MRI-images. In *Medical Image Analysis* 42 (2017) 173-188.

Patent

- **R. Ma**, R. Wang, S. Pizer, J. Frahm, J. Rosenman, and S. McGill. Methods, Systems and Computer Readable Media for Three Dimensional (3D) Reconstruction of Colonoscopic Surfaces for Determining Missing Regions. United States Patent NO. US010682108B1.