Computer Vision

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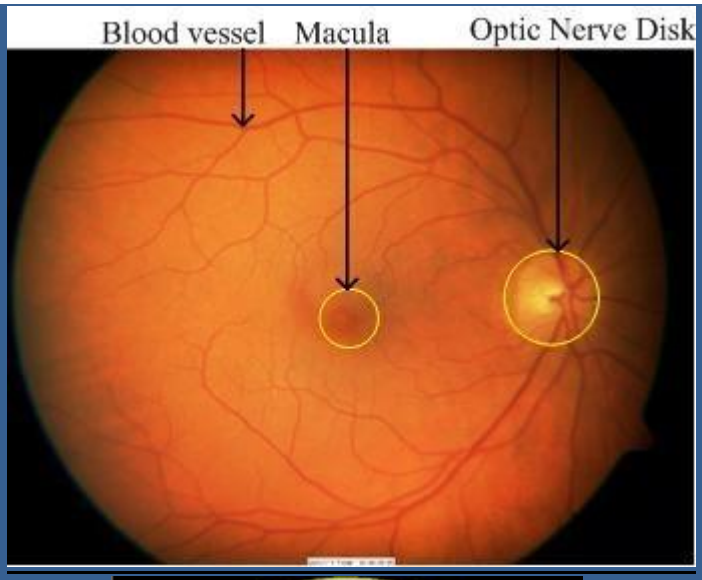
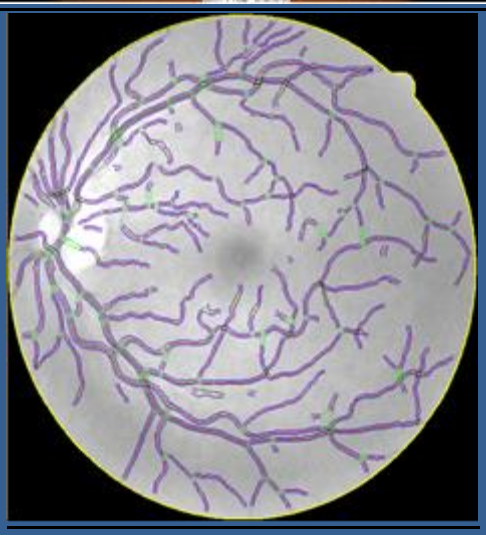
Retinal Image Computing for Early Diagnosis and Treatment

Retinal Image Computing is an exciting, interdisciplinary area of research. Capturing retinal images at higher resolution and with better image quality are always in demand, so we have the opportunity to produce algorithms that will intelligently enhance our understanding to the pathology progress which might produce intelligent diagnosis tools for early treatments. Obtaining quantitative measures is vital for enabling patient information to be compared with existing knowledge or with his historical records.

A fully automated system for retinal vascular analysis has been developed. The system extracts and measures the entire vasculature without user intervention. The segmentation is very complete: it locates virtually all vessels over 2 pixels in width successfully. The system automatically extracts vessels widths along the entire vessel length, and also automatically extracts branching angles at all vascular junctions. Our system also automatically detects and measures the optic nerve head (ONH), allowing us to construct any measures that are related to ONH diameter. In addition to the automated system we have developed manual support tools for vessel width and branching angle measurement.





Join my retinal image analysis group to learn latest technologies in medical image analysis.

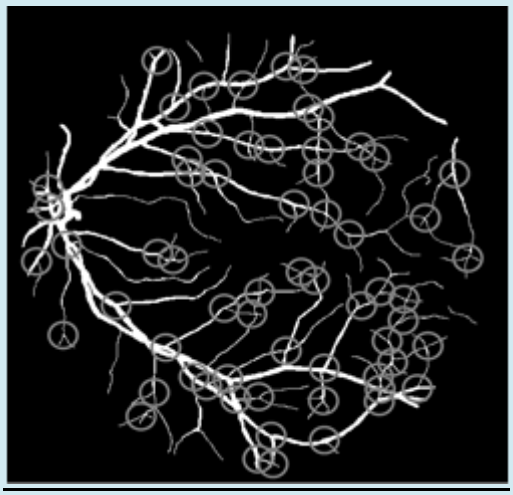
Project 1.

Project Name:

Detection of Retinal Vascular Bifurcations

Project Description:

The analysis of the retinal vascular geometry is important as any deviations from the optimal principles may indicate to one of the vascular diseases, such as diabetic retinopathy, coronary heart disease, stroke, arteriosclerosis and hypertension. The identification of vascular bifurcations is one of the basic steps in this analysis which is currently being performed by a tedious manual process. Automating the identification of these bifurcations will allow increasing the number of research samples and producing more accurate measurements free from human manual errors.



Are there any prerequisite skills / courses?

Computer vision, Matlab

Which degree program is this aimed at?

3rd or Mcomp

Number of students you wish to undertake this project

1

Page Break

Project 2.

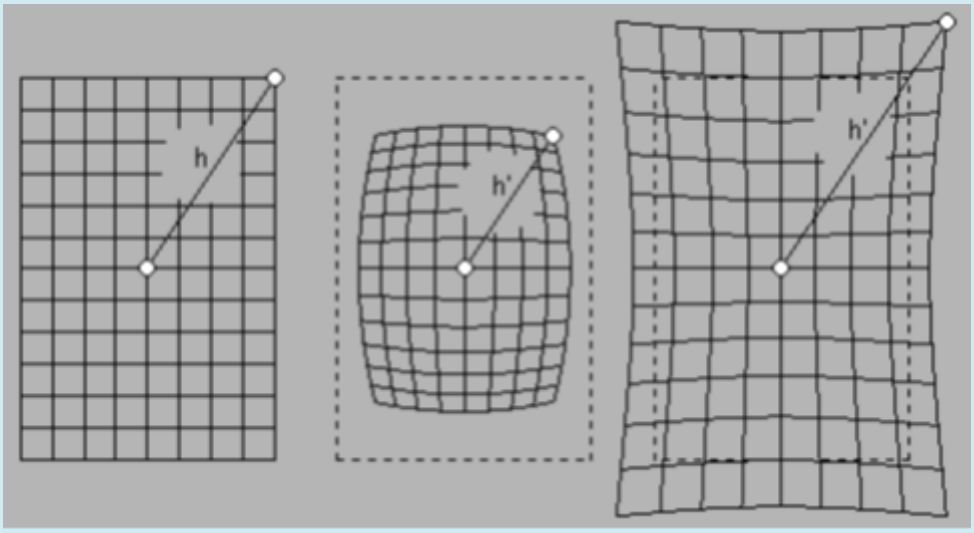
Project Name:

Developing an Algorithm for Compensating Retinal Curve Distortion in Fundus Photography

Project Description:

This project aims to develop an algorithm to compensate for the retinal curve distortion on photos taken with a fundus camera. The algorithm needs to be able to take some set parameters and use a general case model in order to generate a compensated image. Two main types of distortion being applied to the rectangular image. The barrel distortion is smaller than the size of the original image with the

image magnification decreasing with distance from the optical axis. The pincushion model is with the magnification increasing with distance from the optical axis.



Are there any prerequisite skills / courses?

Very Good skills in mathematics

Which degree program is this aimed at?

3rd or Mcomp

Number of students you wish to undertake this project

1

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Project 3.

Project Name:

Differentiate between blood vessel artery and blood vessel vein in retinal images

Project Description:

This project aims to classify retinal vessels into arteries and veins which is an important step for the analysis of retinal vascular trees, for which the scientists have proposed several classification methods. Recently, we published a paper that introduced a manually-labeled, artery/vein categorized gold standard image database, as an extension of the most widely used image set DRIVE.

Are there any prerequisite skills / courses?

Computer Vision, Matlab

Which degree program is this aimed at?

3rd or Mcomp

Number of students you wish to undertake this project

1

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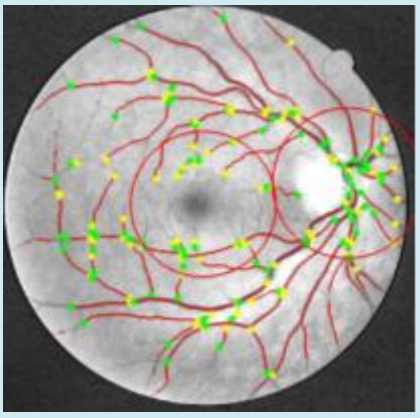
Project 4.

Project Name:

Segment orientation

Project Description:

This project aims to develop an automated system for labelling retinal blood vessels either head or tail based on the direction of blood flow inside these blood vessels assuming all of these blood vessels are arteries based on some geometrical features in the retinal images.



Are there any prerequisite skills / courses?

Computer Vision, Matlab

Which degree program is this aimed at?

3rd or Mcomp
Number of students you wish to undertake this project
1

Page Break

Project 5.

Project Name:
Texture Analysis of Retinal Images
Project Description:
This project aims to develop an automated system to detect areas of abnormality within medical images using texture analysis techniques. These abnormalities will be identified as areas with non-homogenous textures (*i.e.* those areas that are not normal or expected in a healthy image), when compared with the surrounding image. See the figure below for an example of such an image.

Are there any prerequisite skills / courses?
Computer Vision, Machine Learning, Matlab
Which degree program is this aimed at?
3rd or Mcomp
Number of students you wish to undertake this project
1

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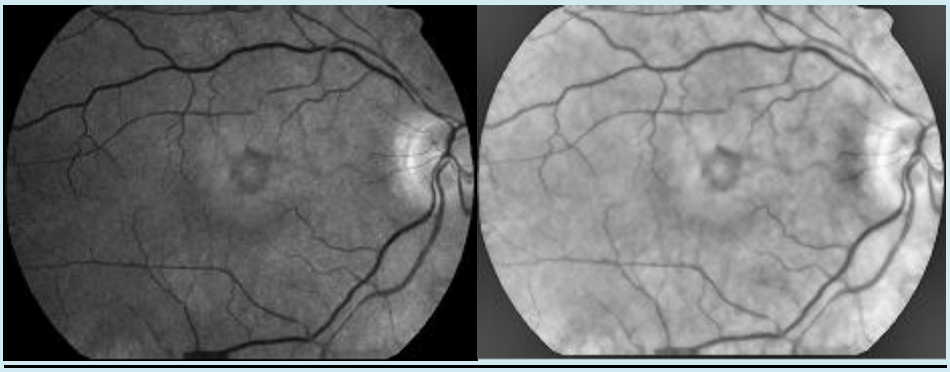
Project 6.

Project Name:

Enhance Retinal Blood Vessel Edges

Project Description:

This project aims to identify the best set of enhancement methods for enhancing the performance of blood vessel edge detection algorithms. A retinal image has blood vessels with varying thicknesses and varying contrasts: higher for thick vessels and lower for thin vessels; in addition, retinal images are non-uniform illumination.



Are there any prerequisite skills / courses?

Computer Vision, Matlab

Which degree program is this aimed at?

3rd or Mcomp

Number of students you wish to undertake this project

1

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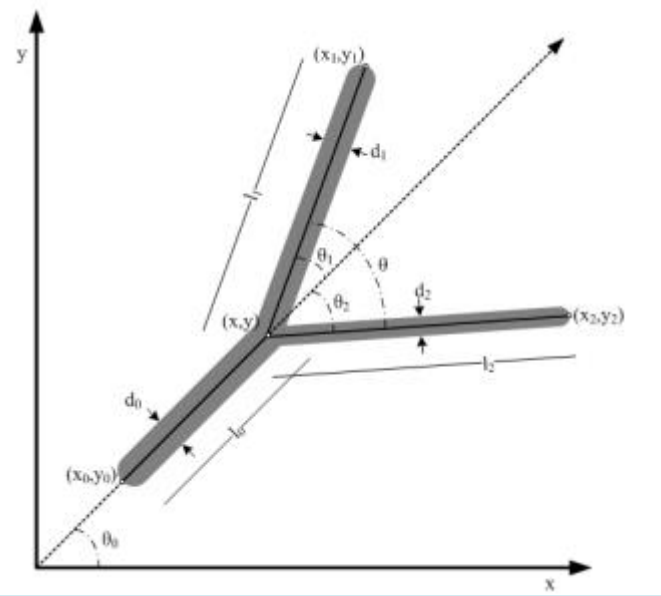
Project 7.

Project Name:

Measuring Retinal Bifurcation Geometry Software

Project Description:

This project aims to re-implement the given retinal research software (written in Matlab) in object oriented language, focusing on the HCI aspects, in order to improve the participation of researchers in retinal medical and research studies, for users with limited software expertise.



Are there any prerequisite skills / courses?

Computer Vision, Matlab, C# or C++

Which degree program is this aimed at?

3rd or Mcomp

Number of students you wish to undertake this project

1

Project 11.

Project Name:

ANALYSIS OF RETINAL VESSEL CONFIDENCE MAPS

Project Description:

The segmentation of blood vessels is a fundamental task in detection/treatment of various medical conditions. The goal of this project is to improve the results of existing vessel segmentation algorithm. You will be provided with images that depict the probability of each pixel being a vessel and ground truth images. Your goal is to create an algorithm to produce binary images: decide if a pixel is a vessel or not.

It is a perfect project for people interested in machine learning and image processing. If you wonder about working in medical imaging in the future then this project is a great introduction. You will have the chance to experiment with various machine learning and image processing techniques.

Are there any prerequisite skills / courses?

Computer Vision, Matlab
Which degree program is this aimed at?
3rd or Mcomp
Number of students you wish to undertake this project
1

Page Break

Project 12.

Project Name:
Analysis of playing fields using thermography imaging from a remote sensing quadcopter
Project Description:
The project aims to build a computer vision system that able to determine the health of playing fields using sets of thermal images, which were taken from the UOL playing fields using a thermal Imaging Camera and a Quadcopter platform. Images were collected from healthy and hardly used pitches. **Can you identify a set of features that can distinguish between healthy pitches and hardly used pitches?**
Are there any prerequisite skills / courses?
Computer Vision, Matlab
Which degree program is this aimed at?
3rd or Mcomp
Number of students you wish to undertake this project
1

Your Name: Dr Miao Yu

Link to your staff profile page: staff.lincoln.ac.uk/myu

Any other relevant links to your research: mlearn.lincoln.ac.uk

Complete this form for each project that you propose:

Project Name
Computer vision based fall detection
Project Description:

Fall is dangerous which could cause serious physiological damages, especially for the elderly people. Although there are some techniques for detecting falls, however they are mostly based on the wearable sensors. This project focuses on developing a camera based non-intrusive fall detection system used in a home environment. Such a system can detect the falling event when it happens, without the needs for a person to wear any equipment. It could be potentially applied for healthcare of the elderly people living alone at home. You will be expected to exploit computer vision techniques for detecting falls based on video recordings by a camera, with respect to the following main aspects: 1). Obtaining human silhouettes in the recorded videos by image processing 2). Extracting some features from the obtained silhouettes which could be applied for detecting falls
Are there any prerequisite skills / courses?
Basic knowledge of Matlab or C++, Image processing, Computer Vision

Which degree program is this aimed at? (It can be more than 1)
B.Sc or MComp.
Number of students you wish to undertake this project
1-2

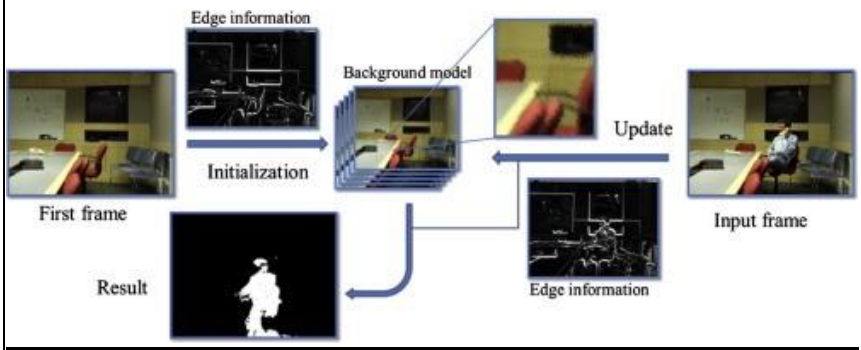
Your Name: Dr Miao Yu

Link to your staff profile page: staff.lincoln.ac.uk/myu

Any other relevant links to your research: mlearn.lincoln.ac.uk

Complete this form for each project that you propose:

Project Name
Computer vision based indoor human segmentation
Project Description:



Human segmentation is a preliminary step for a wide range of applications, e.g., activity recognition, human machine interface, abnormal events detection, surveillance, etc. This project focus on evaluating different human segmentations algorithm in indoor scenarios, to determine which segmentation algorithm is the most effective one applied in the indoor environment.

You will be expected to implement/compare different human segmentation algorithms, including: background subtraction algorithms and deep learning

algorithms, based on video sequences of different indoor daily activities (walking, eating, watching television, etc.)
Are there any prerequisite skills / courses?
Basic knowledge of Matlab or C++, Image processing, Computer Vision
Which degree program is this aimed at? (It can be more than 1)
B.Sc or MComp.
Number of students you wish to undertake this project
1-2

our Name: Xujiong Ye

Link to your staff profile page: http://staff.lincoln.ac.uk/xye

Any other relevant information:

My main research interests are in the area of (medical) image processing, machine learning and computer vision. I would like to supervise the projects related to this field, such as image segmentation, object detection, noise removal, shape analysis, or image reconstruction, etc.

Project Name
Computer Aided Detection of Polyp in Colonoscopy videos
Project Description:
The aim of this project is to develop new approaches, in real time, for automated identification of bowel polyps and cancer through analysis of video recorded data at colonoscopy, by performing computer vision and machine learning technology on each frame. You are expected to implement some of the following tasks 1) develop a software tool to allow the user to manually outline the region of interest (polyp) in a frame of the video. 2) Feature calculation from patches. A number of features including shape, texture or temporal information will be considered for detecting polyp. 3) Classification between polyp regions or healthy tissues. 4) Investigate some

state-of-the-art Convolutional Neural Networks (CNNs) (e.g. VGG16, GooleNet, ResNet and AlexNet) to patch images extracted from video colonoscopy frames to classify patch images into polyp and non-polyp images.
Are there any prerequisite skills / courses?
Basic knowledge of Matlab or C++, Image processing, Computer Vision
Which degree program is this aimed at? (It can be more than 1)
BSc CS, MCOMP CS
Number of students you wish to undertake this project
2

Project Name:
Medical Image Segmentation
Project Description:
Automatic segmentation of medical images is an essential component of a computer-aided diagnosis (CAD) system. The aim of this project is to develop an initial method using image processing and computer vision techniques for segmentation of anatomic structures or tumor boundaries, such as segmentation of brain tumor from different imaging channels, lung nodule from CT imaging, ultrasound image segmentation, or skin lesion segmentation, cell segmentation, etc.
Are there any prerequisite skills / courses?
Basic knowledge of Matlab/C++, Image processing, Computer Vision

Which degree program is this aimed at? (It can be more than one)
BSc CS, MCOMP CS
Number of students you wish to undertake this project
2

Project Name:
A Fantastic Project Idea in the Field of AI, Robotics or Computer Vision
Project Description
You are invited to propose an original project idea in one of the aforementioned topics – **Artificial Intelligence, Robotics and/or Computer Vision**, provided that the proposal is supported by some previous research in the field. This research must include **at least 1 relevant paper** (i.e. scientific journal or conference) to bring with you during our first meeting. Projects in one or more of the following areas are particularly welcome: • Intelligent Environments • Assistive Technologies The project will have to be interesting as well as **technically challenging**, and it will require the development of some artifact using the programming language of your choice (e.g. C++, Matlab, Python, etc.). 
Are there any prerequisite skills / courses?
Good programming skills, as required by the projects.
Which degree program is this aimed at?
CS and GC