

# Helping hand

**In years to come hundreds of thousands of rheumatoid arthritis sufferers may have cause to thank Olga Kubassova, even if they never hear the name of the Leeds University PhD student.**

Kubassova has led the development of technology that could revolutionise how doctors diagnose and monitor the disease, a chronic and progressive condition that afflicts nearly one per cent of UK adults.

This year she will pick up her PhD in computer science for her work developing a novel set of algorithms that can improve on existing methods used to assess rheumatoid arthritis of hand joints.

Before embarking on her PhD, Kubassova defined the nature of the problems facing radiologists and diagnosticians at Leeds infirmary when they treated patients.

Rheumatoid arthritis is an autoimmune disease that can affect any joint, usually the hands and wrist. The body's immune system, which usually fights infection, attacks the lining of the joints, making them swollen, stiff and painful. Over time, the joints become damaged and stop working properly.

One of the most common ways that doctors assess those with the condition is to examine magnetic resonance images (MRI) of the joints.

The images, acquired over a period of time, are enhanced by a contrasting agent injected into a patient's body prior to the scan.

Kubassova discovered there were problems with the scanning process and in the presentation and interpretation of the acquired data, which could be addressed by specialised computer algorithms.

Analysis of the MRI images is performed manually or using commercial, labour-intensive software. The process does not involve image registration or automated segmentation, which might lead clinicians to misinterpret the statistical data that is presented to them.

Kubassova and her colleagues at the university knew that an automated analysis of the images from the MRI scan would help reduce the amount of time a medical expert spends on the process and allow clinicians to achieve a more reliable diagnosis.

'I realised that we needed to develop a system that would do everything — compensate for patient motion, segment the joints and, best of all, automatically interpret a large data set to provide a clear way to allow patient data to be visualised and interpreted by rheumatologists,' she said.



For her doctorate degree, she designed and implemented algorithms that do just that. First, they allow for patient motion correction during the MRI procedure, a process called data registration; second, they provide the ability to highlight tissues of interest, called segmentation; and third, they provide a means to visualise the results to allow clinicians to assess the progression of the disease.

'Patients who come to have their hands scanned are so affected by the disease that they can't hold them still while scanning,' said Kubassova. 'Because the scan takes between three to five minutes, the hand shaking causes the data to be corrupted by noise and other artefacts. So the radiologist won't be looking at a clear data set and the diagnosis might be misleading or even erroneous.' Hence, her registration algorithm is used to correct for such subject movement during the procedure.

The second, segmentation algorithm, is used to detect the regions of interest to the clinician — in this case, the software 'segments out' areas not of interest, such as joint exterior and bone interior, highlighting the areas that are, such as the joint lining.

'There are plenty of commercial software packages that allow you to perform registration and segmentation. However, since the data we are working with is acquired dynamically, standard algorithms for registration and segmentation are not applicable, so we had to develop our own,' said Kubassova.

Once the image registration and segmentation algorithms had produced clear data sets, the data was simplified through the use of an interpretation algorithm that could characterise tissue types and so allow a clinician to track the progress of the disease.

In operation, the algorithm examines image intensity changes within dynamically acquired slices from the MRI system. Since each type of tissue reacts to the contrast agent in a different manner, statistical analysis of the enhancement specific for particular tissue types allows disease-affected areas to be identified.



To track the progression of the disease or effectiveness of any treatment, patients are usually asked to scan their hand again after a long period of time, between three and six months.

Again, alignment of older data with newer data is crucial to the procedure and is another challenge that Kubassova may tackle in the future.

In the meantime, a number of medical experts and several companies have expressed interest in her software, which is versatile enough to be used with different types of scanning equipment used in the medical field. It can be tailored to satisfy many other applications (such as datasets acquired from patients with cancer or tumours), and Kubassova is looking for further interested partners.

The software has already proved itself a success, however. For her efforts, this year Kubassova won the Leeds University inaugural Sir Peter Thompson Award for Enterprise. With such a start behind her, she is planning to generate interest in, and commercialise her algorithms, through her own start-up company, Image Analysis (<http://www.imageanalysis.org.uk/>).

Source: Technology Horizons  
Date published: October 25, 2007

### **Image Analysis Ltd**

Image Analysis Ltd a new Innovative Company ([www.imageanalysis.org.uk](http://www.imageanalysis.org.uk)), which specialises in developing computer-aided algorithm for MRI data analysis. This is of particulate interest in early diagnosis, quantitative evaluation of patient progress and treatment effect. Main applications for the algorithms are in rheumatology, cancer and general immunology. The company's core product Dynamika is currently being used in RCT, R&D projects, and clinical research. Dynamika allows automating clinical workflow and improving data quality, which lead to the increase of productivity of staff, reduction of costs and elimination of human bias from the evaluations. There are number of appealing features such as advanced visualisation and automated reporting system, which give doctors statistical and visual results in a speedy manner.

For information on Image Analysis please contact: Dr Olga Kubassova, Managing Director, Email: [olga@imageanalysis.org.uk](mailto:olga@imageanalysis.org.uk) Phone:+447985939915 or Jeremy Nettle, Chairman, Email: [jeremy.nettle@imageanalysis.org.uk](mailto:jeremy.nettle@imageanalysis.org.uk) Phone:+447774962333