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Science Bridges China Research Profile

Name: **Clive Beggs**

Position: Professor of Medical Engineering

Institute/division: Centre for Infection Control and Biophysics

Email: c.b.beggs@bradford.ac.uk

Tel: +44(0)1274 233679

SUMMARY OF MY RELEVANT RESEARCH AREAS:

mathematical modelling of physiological, clinical and biophysical systems.

生理，临床和生物物理系统的数学模型

Primary Research interests:

Prof Beggs is both a biomedical engineer and a biologist. His particular expertise is in the mathematical modelling of physiological, clinical and biophysical systems. He has a number of research interests, including modelling the: transmission of infection in hospitals (including biophysical interventions); hydrodynamics of the intracranial cavity (i.e. blood and cerebrospinal fluid flow in the brain); blood flow in compliant vessels; and analysis of clinical data and signals.

1. Understanding the role that the environment (in its broadest sense) plays in the transmission of infection both in hospitals and in the community. The aim of this work is to use of advanced mathematical modeling techniques to characterize and quantify the role that various environmental factors (e.g. cleanliness, better ventilation, etc.) play in the spread of infection. Gaining a better understanding of the role played by the environment in the spread of infection will enable superior infection control interventions to be developed – something that is much needed.
2. There is increasing evidence that vascular abnormalities may be involved in the pathophysiology of neurological diseases such as multiple sclerosis and Alzheimer's disease. The body employs and complex windkessel mechanism, which couples the cerebral arterial, venous and cerebrospinal fluid flows in a finely tuned compensatory system to protect the brain. Abnormalities of the venous system appear to alter the behaviour of this windkessel mechanism – something that might lead to a number of pathologies. However, the intracranial regulatory system is poorly understood and its role in the progression of many neurological diseases is unknown. The aim of this work is to mathematically model the intracranial hydrodynamic system, so that its role in the pathophysiology of neurological disease can be better understood.
3. Colour Doppler ultrasound is used to diagnose a number of vascular conditions. However, it is currently a rather crude diagnostic device, with most of the information collected under-utilized. The aim of this work is to develop algorithms to better harvest information from colour Doppler sonography and so improve diagnosis.
4. Computational fluid dynamics (CFD) is frequently used to analyse blood flow in vessels. However, analysis has usually been confined to arterial vessels, whose walls are generally less compliant. By comparison, CFD has hardly been applied to the venous system, despite the fact that veins are associated with a number of pathologies. Veins are particularly floppy and compliant, and this poses major challenges to current CFD techniques, which generally assume the presence of rigid tubes. The aim of this work is develop computational algorithms that will enable blood flow in floppy tubes to be accurately simulated and well characterized.

Topics in which you would like to develop collaborative research:

We welcome partnerships in all the above research areas – infection control, intercranial hydrodynamics modelling, Doppler ultrasound diagnosis, CFD

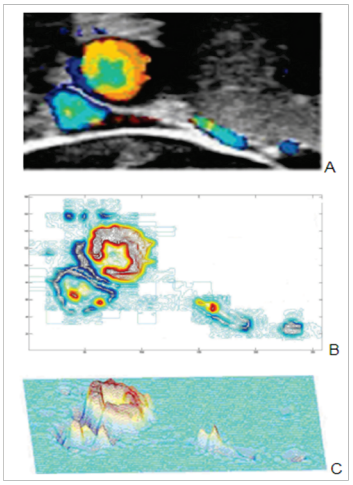
Relevant existing collaborations (academic/clinical/commercial) inside or outside China.
Include here any relevant collaborations you have

Prof Beggs is currently collaborating with:

1. Prof Robert Zivadinov (University of Buffalo, USA) - modelling cerebral blood and cerebrospinal fluid flow dynamics in patients with multiple sclerosis.

2. Prof Paolo Zamboni (University of Ferrara, Italy) - diagnosis and characterization of venous abnormalities in patients with multiple sclerosis.

Relevant graphics, figures, pictures:



(A) Colour Doppler ultrasound image of blood flows in the carotid artery (CA) and internal jugular vein (IJV). (B) Encoded image showing the iso-flows in the CA and IJV. (C) 3D rendered image showing the velocity profiles of the flows in the CA and IJV.

Publications and other outputs relevant to your interest in this programme (up to 5)

1. Magnano C, … Beggs CB, Zivadinov R. Cine cerebrospinal fluid imaging in multiple sclerosis. *Journal of Magnetic Resonance Imaging*. 2012 Jun 25. doi: 10.1002/jmri.23730. [Epub ahead of print]

2. Zamboni P, … Shepherd SJ, Beggs CB. Assessment of cerebral venous return by a novel plethysmography method. *Journal of Vascular Surgery*. 2012 Apr 20. [Epub ahead of print]

3. Beggs CB, … Zivadinov R. Sensitivity and specificity of SWI venography for detection of cerebral venous alterations in multiple sclerosis. *Neurological Research*. 2012 Jun 16. doi: 10.1179/1743132812Y.0000000048. [Epub ahead of print]

4. Zivadinov R, … Beggs CB, Dwyer MG, Weinstock-Guttman B. CCSVI is related to decreased brain venous vasculature visibility on SWI venography in patients with MS. *BMC Neurology*. (2011) 11:128

5. Beggs CB, Shepherd SJ, Kerr KG. Does increased frequency of hand washing by healthcare workers lead to commensurate reductions in staphylococcal infection?: an analytical study. *BMC Infectious Diseases*. (2008) 8: 114