Take AIM

Smith institute
for industrial mathematics and system engineering

Image Ma-therapy: detect or defect?

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A picture of your holidays: nice spot, shining sun, blue sky...wait! What is that stain occluding your face? No problem: open your favourite photo editor, encircle the stain as best as you can and … remove it. Easy. Done. Now the scenario changes: the image you are looking at is the MRI of your brain, and there is something strange in it. A doctor is going to analyse it by hand to check if there is something wrong …

… do you really feel comfortable thinking that a small defect might be crucial for your diagnosis?

Recent mathematical medical imaging methods provide patients and doctors with accurate, non-invasive tools for the detection of suspected areas in the body. They are helpful also in planning therapies, like radiotherapy: through an accurate segmentation of the region of interest, damages to the surrounding, cancer-free tissues are minimised. For large regions with very sharp boundaries, several, almost fully automatic methods exist, but for low-contrast images with very small regions and fuzzy borders, standard segmentation may fail. We use trained algorithms that, by using examples provided by the user, can learn and compare shapes, intensity and texture information to get the desired region, no matter its properties. Mathematically, this consists in solving diffusion partial differential equations defined on a graph (a pixel image) where the connections between pixels represent their feature similarity. Similar methods can be adapted also in zoology, marine biology and much more.

Trust a mathematician: your brain wants it!

The use of mathematics has profound consequences in all walks of life, but the opportunities that it opens up often go unrecognised or underexploited. The Smith Institute, enabled by the generous sponsorship of our leading corporate partners, ran the fourth annual Take-AIM competition in 2014 to make visible the crucial role that mathematics will increasingly play in all aspects of our lives. The competition was open to all undergraduate and post-graduate students working in the mathematical sciences. The author of the best entry received £1,000 of Apple vouchers as his prize, with £500 of Apple vouchers being awarded to authors of the four entries that tied for second place.