Using mathematics to make our digital world safer

TakeAIM Winner 2018:
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Biometric surveillance such as fingerprinting is rapidly becoming an integral component of national security policy and practice, and it is almost difficult not to come across biometric security in everyday life. From airports to banks to professional establishments, biometric security is implemented everywhere and it is an excellent way to keep us secure, while preventing anybody from infringing on our privacy.

Fingerprints are better than any password and are increasingly used in biometric applications to identify individuals. To develop, validate and improve the performance of fingerprint identification algorithms large databases are required. Unfortunately, collecting databases of real fingerprints for research purposes is usually very cost-intensive, requires time and effort, and in many countries, it is constrained by laws for data protection and privacy. Therefore, it is very desirable to avoid all these disadvantages by simulating large fingerprint databases on a computer.

Based on recent biological literature my research aims to model the formation of fingerprint patterns accurately and to simulate realistic fingerprint patterns. I proposed a new complex mathematical model to describe our fingerprint formation, analysed the resulting pattern formation and created biologically meaningful, synthetic fingerprints based on a biologically motivated model for the first time. This new knowledge of the fingerprint formation will be essential to make our new biometric applications more secure, but can also be regarded as a timeless piece of wisdom to the understanding of the human body.

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The Smith Institute, enabled by the generous sponsorship of our leading corporate partners, ran the TakeAIM competition in 2018 to make visible the crucial role that mathematics will increasingly play in all aspects of our lives. The competition was open to undergraduate and postgraduate students working in the mathematical sciences. First prize was £1,250 of Apple vouchers, with nine runners-up each receiving £100 of Amazon vouchers.