Current work is concerned with the automated assessment of Parkinson's disease and other neurodegenerative conditions based on the measurement and analysis of movement disorders and visuo-spatial ability. Features associated with symptoms of these neurological conditions are used to train novel evolutionary algorithms to aid diagnosis, monitoring, and administration of medication. This technology has the potential to transform clinical practice allowing patients to be diagnosed and monitored with greater accuracy than previously possible. Presently, there is poor differential diagnosis of neurodegenerative diseases with high rates of misdiagnosis and low test-retest reliability; indeed, Parkinson's disease has rates of misdiagnosis of 15-26%. Recent work in our lab is using resting state functional magnetic resonance imaging for early diagnosis and also for monitoring drug treatment in Parkinson's disease patients. Early diagnosis of Parkinson's disease is fundamental in providing patients with palliative care during the early phases, enabling effective disease management and maintaining patient quality of life. Moreover, once a neuroprotective drug to treat Parkinson's disease is developed, the early diagnosis of Parkinson's disease would have even greater clinical implications and, consequently, help the NHS save money and improve patient quality of life.

Indeed, an animal model of Parkinson's disease is essential for testing new therapies and determining the molecular basis of the disorder. Zebrafish are increasingly being used to model human diseases, as vertebrates they share a similar body plan to us and much of the genome is conserved. They are also well suited to high throughput drug screening: they can be stocked at high densities due to their small size, they have low maintenance costs and produce large broods that develop rapidly. In order to model Parkinson's disease in zebrafish we have generated multiple mutant lines by targeted mutation of Parkinson's disease-associated genes found in the zebrafish genome. Molecular methods are being used to study the effect had on dopamine neurons in the zebrafish brain, homologous to those that die in people with Parkinson's disease, to evaluate how effective each model is. Each of the mutant lines is recorded swimming as they age, features of movement are extracted from the recordings and used to train an evolutionary algorithm to classify mutants based on movement phenotype. Once trained the evolutionary algorithm, paired with a zebrafish model of Parkinson's disease, could be invaluable for testing new therapies, assessing whether a drug reverts the movement phenotype of a model back to that of a wild type control zebrafish.