

a short-range electrical field just outside the sphere, which can attract nanoparticles, bringing them to the sensor about 100 times faster than diffusion.

On top of this, the nanoparticles, once trapped, start to orbit the sphere. This produces a shift in the resonant frequency in the WGM, which in turn permits estimation of the size and, by extension, mass of the nanoparticle. WGMs could have applications in biosensing.

NEUROSCIENCE

Tetrapack protein

Cell **137**, 159–171 (2009)

The connections, or ‘synapses’, between neurons change in both strength and shape in response to consistent use — a mechanism thought to underpin learning and memory.

Mariko Kato Hayashi of the Massachusetts Institute of Technology in Cambridge and her colleagues now show that the protein Homer forms tetramers — proteins with four subunits — whose multiple facets could help to coordinate signalling and shape changes at excitatory synapses in the central nervous system.

The researchers show that purified Homer filaments self-assemble with globular hubs of the protein Shank to form a mesh-like polymer matrix that can still incorporate other Homer-binding proteins.

A mutant form of Homer disrupted both the tetramer and the Homer–Shank matrix *in vitro*, and affected synaptic structure and function in cultured neurons and brain slices.

NANOTECHNOLOGY

The new heat order

Nano Lett. doi:10.1021/nl900399b (2009)

The extreme miniaturization that is reached in micro- and nano-electromechanical devices also generates a lot of heat at specific points. This heat has to be dissipated to stop the device from deteriorating, but normal heat-management techniques, such as metal wiring or fluid cooling, do not work well for sources of this size.

Zhiping Xu and Markus Buehler at the Massachusetts Institute of Technology in Cambridge used a theoretical model to evaluate the heat-dissipation performance of hierarchical networks composed of one-dimensional filaments — for example, linked carbon nanotubes. The authors discovered that, even with the same number of dissipating nodes, these structures are much more effective than non-hierarchical configurations.

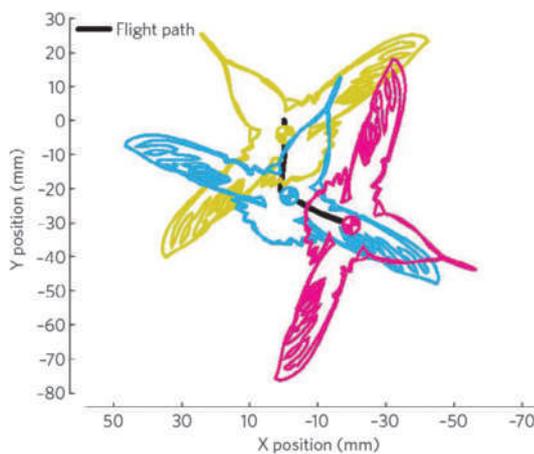
LOCOMOTION

Elegant flappers

Science **324**, 252–255 (2009)

How do birds and bugs that flit through the sky execute precise manoeuvres such as sharp turns and, at the same time, exhibit such stability that crashes seldom occur? Tyson Hedrick of the University of North Carolina at Chapel Hill, and Bo Cheng and Xinyan Deng at the University of Delaware in Newark explain this aerial prowess with a model of ‘flapping counter-torque’.

Focusing on low-speed side-to-side turns of 60° or more (see picture, below), the researchers found that flapping fliers of all sizes — from fruitflies to cockatoos — rely on the turning movement itself to create an asymmetry in velocity between the inside and outside wing and end the turn. That is, they don’t have to actively put on the brakes to avoid overturning; their wings do it for them.



AAAS

CANCER

Dual aspect

Genes Dev. **23**, 877–889 (2009)

Acute myeloid leukaemia in humans can be caused by different genetic changes that translate to markedly different responses to standard therapies.

Scott Lowe at Cold Spring Harbor Laboratory in New York and his colleagues created mice that closely resemble two common variants of the disease. The team irradiated the animals to kill off blood-cell precursors and then injected them with blood precursor cells that had been genetically modified to recapitulate one of two types of leukaemia. As in the human forms, one was very responsive to treatment, the other resisted common therapy.

In addition to providing new insight, the mice may make for a good preclinical model for drug screening, the authors say.

JOURNAL CLUB

Daniel Charlebois

University of Ottawa, Canada

A biophysicist ponders the application of hidden metric spaces to genetic networks.

Complex networks can be conceptualized as a collection of points or ‘nodes’ connected by edges that represent their interactions. The structure and logic of these visualized networks allows mathematical modelling to investigate dynamics such as how information propagates through a system. I am particularly interested in gene regulatory networks — ensembles of molecules and interactions that control gene expression — because of their connection to human diseases such as cancer.

Marián Boguñá and his colleagues suggest that real, observable networks are underlain by geometric frames that contain all nodes, influence topology and guide information-routing decisions. They call these underlying frames ‘hidden metric spaces’ (M. Boguñá *et al. Nature Phys.* **5**, 74–80; 2009).

In addition to the distance between nodes in the observable network, one can measure similarity between nodes — which can be determined by, for example, how many neighbours they share — and abstract it as a ‘hidden distance’. Hidden distances are then used to define the hidden metric space that would place similar nodes closer together, increasing the probability that they are connected and interacting in the network.

A major challenge to applying this framework is explicitly identifying the structure of the hidden metric space for complex networks, for which data sets are often noisy or incomplete. For genetic networks, hidden distances could be abstracted from available data such as tissue-expression profiles. Comparing hidden metric spaces constructed from different data types with known genetic interactions would identify which data are best suited to the process. It will be interesting to see what this reveals in terms of the structure and dynamics of genetic networks.

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