

An eye to the future of digital vision

Despite all our technological advances, it is still often hard to beat nature when it comes to solving problems. Now a project is taking its inspiration from the insect world to build a man-made compound eye, designed to detect motion with a high temporal resolution.

Compound eyes are a truly astounding feat of evolution. They appeared on the scene hundreds of millions of years ago and are found today in insects and many other animals. Made up of hundreds or even thousands of individual lenses, compound eyes are perfectly fit for detecting movement: as a predator or prey crosses the eye's field of view its image is progressively picked up by lenses across the eye.

The researchers are working on a vision sensor that will be well adapted for accurate and fast navigation in three dimensions. Compared to conventional cameras, artificial compound eyes will offer a much larger field of view in a smaller size and weight. The Curvace eye will be able to locate contrasting objects and detect motion with very high accuracy over a wide visual field — the distance between the lens surface and the

The plan is to construct three eye shapes: cylindrical, spherical and tape (flexible), which could have a wide range of applications. You could stick a tape Curvace for example on the backpack of a child or on the hat of a blind person. The 'eye' would be able to detect obstacles in front or the approach of a fast car from the side.

The testing of prototype Curvace eyes will again take inspiration from nature. The team plans, in particular, to assess the performance and benefits of the eyes for navigation in flying micro-robots and as wearable sensors.

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Scientists participating in the 'Curved artificial compound eyes' (Curvace) project have set out to copy the compound eye design. The idea is to build curved arrays of microscopic lenses, with each lens focused onto a photoreceptor. When light passes through a microlens at the right angle it will hit the receptor and trigger an electric signal; the signals coming from the eye can be combined and analysed to provide a stunning level of detail about the movement of objects picked up by the lens.

photoreceptors will indeed be constant over the entire field of view, which is not the case in conventional cameras.

The project partners also want to produce eyes of different shapes, effectively bent to the contours of different surfaces. The project is testing a unique fabrication process in which flat patches of 'eyes' (clusters of lenses and their photoreceptors) will then be flexed, keeping the optics perfectly aligned to maintain the core functionality of the compound structure.

Curvace — Curved artificial compound eyes

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Total cost: EUR 2 726 578

Starting date: 1 October 2009

Duration: 42 months

Coordinator: Ecole Polytechnique

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