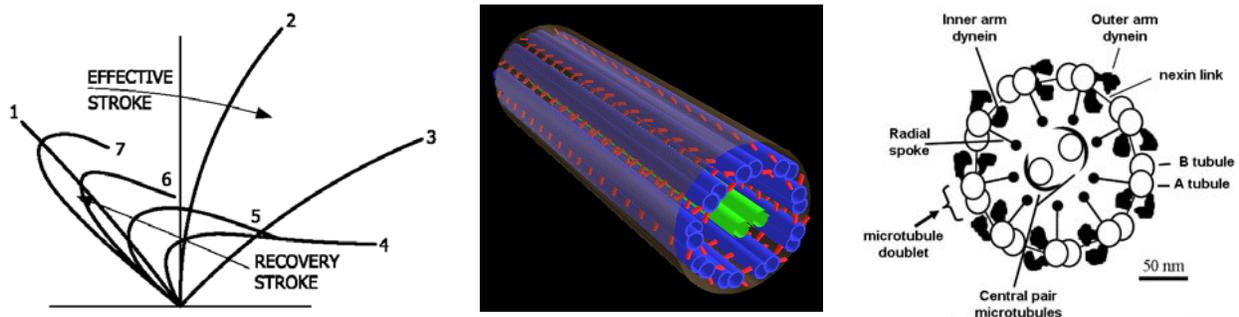


Post-doc position “Mechanics of ciliary motion”, 12-14 months.  
University of Groningen, Faculty of Mathematics and Natural Sciences, Zernike Institute for Advanced Materials, Department of Applied Physics



Natural cilia are small hairs with a typical length of 10 micrometers with a circular cross-section with radius  $0.1 \mu\text{m}$ . The movement of the cilia is asymmetric, i.e. a deformation cycle consists of an effective stroke and a recovery stroke, so that fluid transport in one direction is induced (see Figure, left). Ciliary motion can be characterized by a series of bends originating at the base and propagating towards the tip. The underlying biological mechanisms that are responsible for the movement are not yet understood.

The asymmetric ciliary beat cycle is fully controlled and powered by the internal microstructure of the cilia, called the axoneme (see Figure). The axoneme consists of a central pair of singlet microtubules, surrounded by 9 outer doublet microtubules. The microtubules in the axoneme are bound together by three sets of protein cross-links: bridges that connect the central singlet microtubules, nexin bridges that join adjacent outer doublet microtubules and radial spokes that point from the outer doublets to the inner singlets.



**Motion and microstructure of cilia.** Asymmetric cycle of ciliary motion (left) [from: Sleight, *Cilia and flagella*]. Internal microstructure of cilia, the axoneme (middle) [from: [www.udel.edu/Biology/Wags/wagart/modelspace/models.html](http://www.udel.edu/Biology/Wags/wagart/modelspace/models.html)]. Cross-section of the axoneme (right) [from: [www.uwlax.edu/biology/faculty/Howard/Chlamy.htm](http://www.uwlax.edu/biology/faculty/Howard/Chlamy.htm)].

The basis for the axonemal motion is the sliding of the outer doublet microtubules relative to each other. The sliding forces are generated by the motor-protein dynein that 'walks' over the neighboring doublet. How the overall beat cycle is related to the internal sliding motion is a complex problem and, as of yet, not fully understood. The goal of the project is to develop a mechanical model that explicitly represents the ciliary axoneme, based on which the asymmetric ciliary motion can be simulated.

Candidates should have a university-degree in biology, physics, materials science or mechanical engineering, with a strong affinity for theoretical/numerical modelling. For information and applications contact Patrick Onck, [p.r.onck@rug.nl](mailto:p.r.onck@rug.nl), tel. +31 (0)50 3638039, <http://micromechanics.phys.rug.nl/~onck/>.