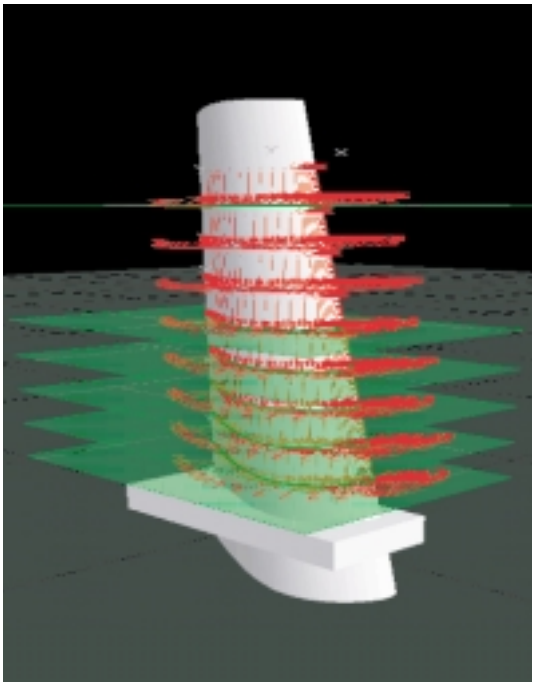
R&D

Intelligent task planning for robotics grinding applications

The complex surface geometry of turbine blades and the exceptionally high machining quality that is required to manufacture them calls for very careful planning of the blade grinding process. The key is to select a set of grinding wheels that will adapt to the actual geometrical condition of the polished surfaces. Currently, robot grinding is planned manually by specialist workers with many years' experience. Planning work commonly starts with the partitioning of the surfaces into different zones for grinding by differently sized wheels. Next, the paths are planned by specifying the trajectory of the robot's movement.

Although there has been a demand for automated robot grinding path planning for many years, no successful automated planners have as yet been reported. The challenge stems not only from the fact that this is an extremely complicated task demanding efficient, reliable and robust computational geometry tools, but also from a lack of systematic approaches to such a tough problem.



In collaboration with Prof. Prinz at Stanford University, ABB has implemented a mathematical algorithm which finds the optimal and automated partition of a planar contour. For a given set of contact wheels, the proposed scheme automates the determination of the grinding segmentation on a workpiece and the selection of an optimal subset of contact wheels. Besides minimizing the total grinding time, this approach also improves the quality and efficiency of the grinding process. The development of this optimal partitioning scheme will facilitate the future development of a fully automated robot task planner for robot grinding processes.

Masonry on an atomic level

Around the world, intensive research is going on in the field of nanotechnology, and ABB foresees a promising future for it in many areas. Nano-engineered structures, such as coatings just one atom thick, display astounding properties. Imagine materials with no resistance or a surface coating that prevents electrical breakdown, or miniature tools, or …

Nanotechnology involves manipulating tiny building blocks (structures and materials smaller in one dimension than 100 nanometers), such as atoms and molecules, and using them to create new materials and surface coatings. These may have completely new, and even unexpected, properties.

Thomas Liljenberg, responsible for the thirty or so researchers from Europe and the USA working on ABB's nanotechnology research program, describes for us how this nascent science can contribute to ABB's future products and increase ABB's competitive edge.

"This new-found knowledge will eventually revolutionize both high-tech products, such as computers, and the more traditional products, like high-voltage equipment. In recent years,

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ABB's international research program for nanotechnology, under the leadership of Thomas Liljenberg, is so far mainly a 'greenhouse' for coming products, based on cultivation of knowledge and monitoring progress in the field. Photo: Marianne Lindeborg

nanotechnology research has seen enormous growth, led by universities and major corporations in the US and in Europe. ABB is actively involved."

"We are seeing the birth of a new science", Liljenberg continues, "one that can contribute greatly to ABB's future. But so far, the research program is still in a 'greenhouse' phase; we're mainly keeping an eye on development, building up our skills and carrying out research activities, including university collaboration."

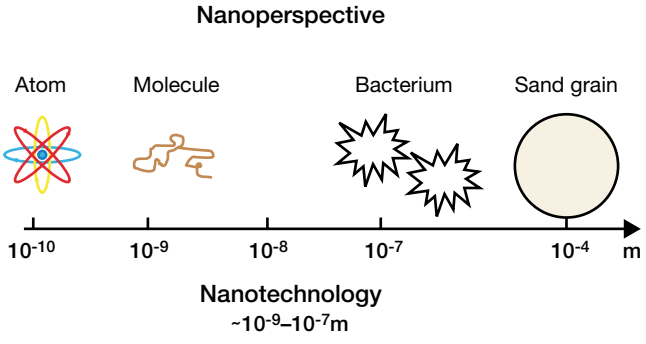
In university laboratories, research is proceeding at full speed. Researchers are disassembling particles in a controlled manner, manipulating individual atoms and molecules, and rearranging them in structures or incorporating them in surface coatings. It is remarkable how materials can take on completely new and sometimes previously unknown properties when they are drastically reduced in size to the nanometer range. Fine atomic threads are a good example.

"Nanotechnology allows us to do new things with traditional technology. For example, materials may display reduced conductivity and a new cable surface coating can be created which significantly reduces the risk of electrical breakdown", explains Liljenberg.

Current ABB/university collaborations involve trials with nanotechnology products such as carbon nanotubes. These are molecule-sized tubes of carbon atoms that are stronger than steel and whose electrical resistance varies when they are bent – a potential material for applications such as sensors.

Another possible application area for carbon nanotubes is in the storage of hydrogen gas used

Small, smaller, smallest. Nanotechnology involves particles so small that, a few years ago, researchers couldn't even see or manipulate them. Today, we have both high-power microscopes and production technology for this work.



in fuel cells. This would certainly give a boost to renewable energy development.

Today, materials, powders and composites are being produced using nanotechnology; catalytic materials, surface coatings, filters and sensors are already available to a limited extent. Further along the line, there will be miniature tools, such as a pump that could fit inside a blood vessel, nano-robots, quantum computers for data storage, and a large number of devices for medical applications.

"At ABB, we are concentrating on the electrotechnical, sensing, catalytical and coating fields. I firmly believe that within five to ten years the majority of ABB's products will incorporate nanotechnology and that nanotechnology will help create several new products for ABB", predicts Liljenberg.

For more information contact Marianne Lindeborg at marianne.lindeborg@telia.com

ABB with closer links to Stanford

ABB has decided to join the Stanford Networking Research Center (SNRC).

The SNRC aims to address key research, education, and technology development challenges – and capture emerging opportunities – created by rapid advances in Internet technologies and exploding user demand for ubiquitous access to sophisticated information services.

Three strategic research directions of great interest to ABB – wireless access, Internet technologies and information services – are currently included in the SNRC's broad technical scope.

The SNRC was established in 2000 as a partnership between the School of Engineering, leading information technology corporations and Silicon Valley industries. The center's current core of technical experts comprises twenty engineering faculty investigators and over forty PhD students – a substantial research force indeed.

In joining SNRC, ABB finds itself in an exclusive club of companies like 3Com, Cisco systems, Bosch, Philips and Toshiba.

The Center runs a number of projects within the areas mentioned above, topics of particular note being:

- The optical Internet – the next generation. This project addresses the critical challenges faced by the emerging 'optical Internet' and the associated enabling technologies.
- A Distributed Wireless Communication system. This focuses on research issues associated with the rapid deployment of a communication infrastructure for a large number of mobile devices that self-configure into a distributed network.

Through SNRC, ABB will gain access to important research in the emerging areas of wireless access

Stanford University's appreciation of expertise is also evidenced by its Rodin Sculpture Garden, which contains the largest public concentration of Rodin's bronze sculptures in the world ('Gates of Hell' pictured).

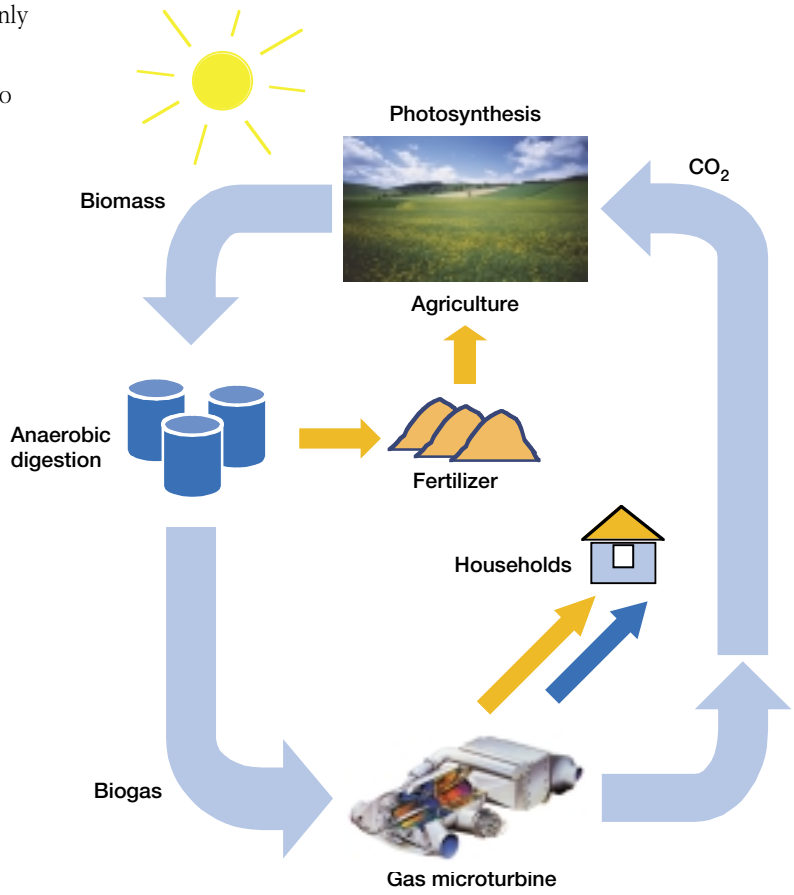
and Internet technologies – important enablers for ABB's Industrial IT concept. Also, the cooperation will enable ABB to increase its presence in the Silicon Valley area, providing links to the IT industry in this region.

ABB developing waste-to-energy system

In recent years biogas from organic waste has emerged as an attractive alternative energy source not only for municipal plants and agricultural applications but also for industrial purposes. Biogas, a saturated gas consisting mainly of methane (60–80%), is produced from organic waste by anaerobic (oxygen-free) digestion with bacteria. Anaerobic digestion is a decomposition process in which micro-organisms stabilize the organic solids. The biogas which is generated is then used to produce heat and power. Besides utilizing the heating value of the organic waste to generate combined heat and power (CHP), this process has two other key advantages: it significantly reduces the cost of the waste treatment and its 'leftovers' can be used as fertilizer (see figure).

ABB is actively participating in this development by applying new anaerobic digestion techniques to biogas production. In the future these techniques will be effectively integrated with clean, efficient CHP generators, resulting in reduced mass flows, smaller plants and lower mechanical treatment costs. In addition, the ABB concept will be modular, highly automated and more flexible than larger biogas-to-energy conversion plants.

ABB Alternative Energy and ABB Contracting are evaluating several technologies for producing biogas and integration with distributed generators. It may be possible to use the Turbec microturbine (an ABB/Volvo joint venture) to generate CHP from biogas. Medium to large-scale farms, municipalities and industrial firms would certainly benefit from such technologies.



The installation of pilot plants in Germany and Sweden is currently under consideration.