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this issue

algorithmica wins a place in the land of ideas!

Deutschland
Land der Ideen

Awarded by the president of Germany and sponsored by Deutsche Bank, the land of ideas demonstrates the innovative power of Germany. With the technology OMEN, algorithmica has won such a place. The jury especially liked the possibility to significantly reduce emissions by increasing industrial efficiencies. Green-Tech is a major initiative for the future, not only of the plant, but the economy and OMEN can play a central role in this. Most other initiatives focus on some form of engineering or hardware approach. Very few projects can add the knowledge required to properly utilize the hidden potential in that hardware. Using artificial intelligence, OMEN is capable of learning automatically the way in which processes work and can then tell human operators how to run them optimally. In this way, OMEN can contribute about 10% of the emission reduction goal.

The efficiency of fossil fuel power plants can be increased

A fossil fuel power plant makes steam by heating water with a fire from the fossil fuel. The steam turns a turbine which makes electricity via a generator. Seemingly simple, this process has significantly different efficiencies depending on the way that the power plant is run.

There are many parameters that can be adjusted in a power plant's equipment. This starts with the way different types of fossil fuel are mixed and continues with the way that this mixture is loaded into the furnace.

The firing pattern and the steam generation are variable. The turbine and the generator have many adjustable parameters also. In total, the power plant is like a radio with dozens of knobs that need to be tuned accurately in order for the entire plant to perform optimally.

Moreover, the whole process is not static. As the quality of the fuel changes or the outside temperature rises and falls, the process changes and so must the parameterization of the plant in consequence to this change in boundary conditions. Roughly once per hour a change must be made in some parameter(s) for the plant to remain at optimal efficiency.

Which parameter this is and what its optimum value is at each moment must be computed based on a mathematical model. OMEN is capable of doing both and communicating simply, practically the message to the operating personnel.

Without a mathematical model – or having a model without the optimization – puts the operating personnel on the spot. It is now them who must make the changes. In view of the fact that several thousand measurements are taken second by second throughout the plant and that dozens of parameters can be changed, this task is too much for any human being. Moreover, the operating personnel is really a group of people that rotates control over the plant in shifts. No single person ever has complete control because he "inherits" the plant from his predecessor in a certain situation. In an eight hour shift, there is only so much he can do to bring the plant to optimum conditions before the next shift takes over again.

A philosophy of running the plant must be implemented that holds at all times. This can only be supplied by a computer program.

In addition, by being guided by a computer program, the operating personnel can develop more knowledge about the plant and become better themselves.

All in all, the efficiency of a power plant is not nearly as static as the general public is lead to believe. It is influenced by its operators and it can be significantly increased by use of analytical artificial intelligence.

This means about 1% more efficiency on average which translates to more electricity per ton of fossil fuel, to a lower number of power plants needed on the whole and, of course, to a lowering in greenhouse gas emissions.

Micro-Injection Moulding to be optimized by algorithmica

Micro-Injection moulding produces very small parts from plastics, metals and ceramics like the one seen above. Such parts are very small as compared to a match above. The process of moulding them is complex and differs in important ways from macro-injection moulding. As the micro parts are often intended for medical purposes or expensive products like watches, the quality demand is very high.

For any part produced, the question is whether the part is good or not. The second question is how to reduce the rate of producing bad parts. Both questions will be addressed in an international research collaboration lead by algorithmica for the next two years and funded by the European Union.

The goal is to develop a software that is capable of learning the quality of a part from production data of the injection moulding machine. This program can be installed in the machine and thus increase the quality of parts. The international market for such a technology is large and there is no competing development available.

Turbines can be diagnosed in many ways

Turbines are among the most critical equipments in power plants. Diagnosing when they are about to fail is a major challenge …

Turbines fail due to a variety of potential causes. Blade tears, as were discussed in the last issue, are just one example of possible failure modes. It is desirable to be able to predict many different turbine failure modes. For this purpose, algorithmica has started cooperation with Siemens Power Generation, particularly the Power Diagnostics Center that oversees several hundred turbines employed worldwide.

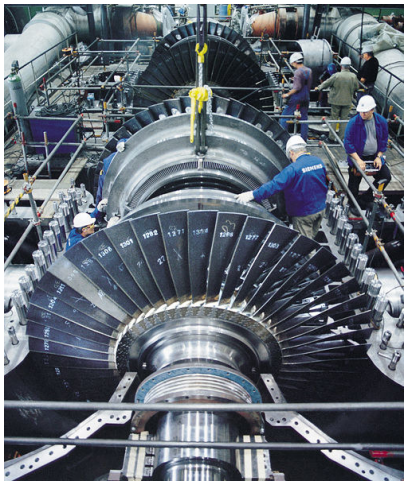
The purpose of the cooperation is to validate NEMO's capability to predict failures on a variety of failure modes from different turbines.

Data from around each turbine will be collected over approximately one year's normal operations. Various vibrations inside the turbine are the primary indicators of trouble but also the pressures and temperatures of the gas and steam involved are important as are the generated amounts of power.

All this data will flow into NEMO, which will then create a dynamic model of the turbine and forecast its future operation. As seen in the past example of the blade tear, approximately two days can be predicted well. The predictions will then be checked against real experience and NEMO's performance assessed on this basis.

The cases chosen will be cases in which there has been some form of gradual degeneration of the turbine so that the model does have a chance to "see" the problem coming. A truly spontaneous event, of course, cannot be predicted by any method.

After a correct prediction is made, there remains the issue of localization of the problem. Just as with the blade tear problem, we will perform data-mining to determine the root-cause of the problem.



That is, the cause will manifest itself on a select few measurements before all others and this will therefore allow a localization of the problem in the space of available data. This must then be analyzed by human experts to find the physical location on the turbine where the problem really exists. In consequence, the operator will be assisted in the problem identification both in time and in space. This allows the turbine then to be powered down and maintained before the event occurs. Due to the prevented collateral damage and the following long shutdown period, this is worth significant amounts of money.

This prediction service could then potentially be offered as an integrated service for all customers of turbines so that they do not have to worry about predictions themselves. The global turbine monitoring center would simply include prediction and notify the turbine owner if a problem is in the making.

At the moment, it is not anticipated that the nature of the damage can be diagnosed automatically as well. In order to label an event with a text such as "blade tear" requires significant samples of such events and this data is scarce due to the fact that turbines are generally very reliable machines.

Nevertheless such a problem diagnosis in addition to prediction and localization is a possibility for the future if and when enough sample data becomes available.

This is an exciting cooperation with a turbine manufacturer and we will report on the progress of this cooperation here in the future.

Plans for Next Quarter

1. The initial foray into China proved successful. We are thus planning a more structured approach to the Chinese market that will include a public conference organized by us in Beijing in January. We will conduct one-to-one meetings with some of the largest oil and gas and power generation companies in China and Hong Kong in order to generate interest. It is our goal to find our first Chinese client in the next quarter and to begin the project for this client in the second quarter of 2010. Should this prove successful, we will investigate the formalities of creating a China presence of algorithmica.

2. We will report on our past progress in several important and public ways. In an academic conference of the German Association of Engineers (VDI), we are presenting our turbine model. In a conference dedicated to maintenance, we are presenting our catalyst prediction model. In a Europe-wide conference on power generations, we are presenting our power plant efficiency increasing model. All these events are high-profile conferences that will increase our exposure in Europe significantly. We hope to generate interest among potential client companies in Europe this way as well as to deepen our academic track record of publications.

3. As we are increasingly working at capacity, we will be looking at introducing an extra layer of management into the company. For this purpose, we will be slowly recruiting project and product managers. These positions will allow more specialization among the workforce and will thus yield faster projects.

This is a slow process that will probably take several quarters. With the end of the financial crisis, the number of projects is increasing at a rate that is very encouraging indeed and the need for more management is becoming apparent. We are accepting applications now.

What is ... parallelism ?

Computations made on a computer take time. To speed them up, we have two choices: Make the individual processing unit faster or use several processing units. Splitting a single task into sub-tasks that can be solved by several processors simultaneously is called parallelism.

The splitting of the task into sub-tasks and the combination of the sub-solutions into the whole solution are of course computations that cannot be done in parallel. Also, the sub-tasks must usually be coordinated just like the project management of a team of human actors must be coordinated by the management of the project. Therefore, the parallel processing of a task by N processors does not take 1/N of the time. In fact, the coordination activity takes so much time that generally the speed up increases logarithmically. Practically that means that beyond a certain number of processors, adding more processors will no longer improve the computation time because the advantages are completely counteracted by the coordination effort.

All of us encounter this while planning our calendar. If this task takes an amount of time comparable to actually doing the tasks on the calendar, we have reached the same sort of limit. At this point, it is time for a paradigm shift: Adding power no longer does it, we must add knowledge in the form of algorithms.

EYE ON IT

Clients / Partners :

- Alfa idei NEW
- Aluminium Norf GmbH
- Bayer Technology Services GmbH
- BASF Corporation
- BP Global Solutions
- Bruker Elemental GmbH NEW
- Bruker AXS NEW
- EADS N.V.
- EVONIK degussa GmbH
- Fraunhofer-Institut für Fertigungstechnik und Angewandte Materialforschung
- Infracor GmbH
- Institut für Internet-Sicherheit
- Klöckner Desma Schuhmaschinen NEW
- METRO Cash&Carry Deutschland
- mobile solution group GmbH
- Momentive Performance Materials Inc.
- National Aeronautics and Space Administration
- nicos AG
- Reiner Microtek NEW
- Rhenus Lub GmbH & Co KG
- Rieter Automatik GmbH
- RWE AG
- Ryanair Ltd.
- SASOL Solvents Germany GmbH
- Siemens Power Generation NEW
- Tchibo direct GmbH
- Technologie-Zentrum Informatik
- ZF Friedrichshafen AG
- T-Systems Enterprise Services
- TUI AG
- TÜV Rheinland Group
- UNI Dai-Ichi Shoji Co. Ltd.
- Vattenfall Europe Berlin AG&CoKG
- VESTOLIT GmbH & Co. KG
- VHV Vereinigte Hannoversche Versicherung a.G.
- Volkswagen AG
- Volkswagen Plant Salzgitter

Professional Development

Do you want a challenge? We constantly seek bright people to add to our team of expert problem solvers. We offer internships, trainee programs, part-time & full-time professional employment. Contact us and experience working on state-of-the-art solutions within a friendly team.

Upcoming Events

- **Chinese Energy Society Seminar; Beijing** 19.01.2010

  This seminar is our first large event in China to generate interest for our products among the energy and chemical industries there.

- **Main Days; Berlin** 18.03.-19.03.2010

  This event concerns itself with maintenance. We are giving a presentation here.

- **VDI-Tagung Schwingungsanalyse; Leonberg** 23.03.-24.03.2010

  This technical conference is on the topic of analysis of vibration data. We are presenting a 48-hour steam turbine failure prediction model.

- **POWER-GEN Europe; Amsterdam** 08.06.-09.06.2010

  This technical conference is on the topic of power generation. We are presenting a model to increase coal burning efficiency by more than 1% is a standard combined heat and power coal power plant.

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