NAIST® Research Highlights

Nara Institute of Science and Technology | **Intelligent System Control Laboratory** www.naist.jp/en

A new artificial intelligence system can considerably boost efficiency in an optical grid.

Applied informatics

Raising optical grid efficiency

Dynamic decision-making tools can improve the flow of information over ultrafast optical grid networks

Computers that share processing power and data storage through a grid of high-speed fibre-optic cables can maximize their productivity with a new artificial intelligence system developed at Japan's NAIST[1].

Takuji Tachibana and colleagues at Kenji Sugimoto's Intelligent System Control Laboratory have worked out a technique for dynamic, on-demand allocation of computer and optical-grid resources that can benefit applications ranging from massive particle accelerator experiments to consumer video editing.

Before individual computers can access the optical grid, they must make contact with a machine known as a job manager. This computer system establishes 'lightpaths' (direct connections between nodes that can transfer thousands of terabytes per second) for the requested processing task. Because the lightpaths and computing power available are finite, the job manager must carefully manage the network connections to ensure that computations run at smooth and stable rates for all users.

Although much attention has been paid to optimizing lightpath connections, Tachibana and his co-workers realized that improving connections between computers and the optical grid could considerably boost efficiency. For example, one problem with the job manager is that it needs to store a constant number of tasks in its memory buffer at all times to complete job executions without delays. Most existing job managers, however, lack the computing resources to satisfy this requirement.

To solve this, the researchers used proportional-integral-differential (PID) control theory to preserve the memory buffer by regulating the tasks sent to the job manager. Then, they implemented two kinds of model-predictive-control (MPC) methods to intelligently handle the needs of both lightpath generation–release processes, as well as computing client demands. "PID control has been used in industry for decades, and is widely recognized as practical," says Sugimoto. "MPC is rather new, but the quality of this method is attracting much attention."

The team's simulations showed that their approach can make the number of tasks stored in the buffer closer to ideal quantities than other, contemporary controllers. Furthermore, it had the ability to dynamically adapt to lower-specification computers appearing in the network — features that can speed implementation of existing hardware into future optical grid systems.

Sugimoto has confidence that this approach could improve communication between information technology researchers, as well as within the optical grid. "Studies of communication and control used to be closely related, but they have progressed in different ways," Sugimoto notes. "This work brings them together through the problem of optical grid."

Reference

1. Matsui, G., Tachibana, T., Kogiso, K. & Sugimoto, K. Dynamic resource management in optical grid. *IEEE Transactions on Control Systems Technology* **22**, 1607–1614 (2014).

More information about the group's research can be found at the Intelligent System Control Laboratory webpage:
http://genesis.naist.jp/?lang=en