Global Scheduling of Periodic Tasks in a Decentralized Real-time Control System

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Abstract

A decentralized real-time control system is one in which the control is devolved to a set of loosely coupled nodes that are connected by a broadcast bus. The control software of the system consists of precedence constrained tasks which run concurrently in the nodes. Each task consists of elementary modules that are spatially distributed over the nodes and which communicate with each other via the bus. The tasks compete with each other for the node processors and the bus for completion before their deadlines. In order to meet the end-to-end deadline requirements of all the tasks the allocation and the scheduling decisions should be planned at design time. This needs a plan which defines the space, the time and the order of execution of the tasks in the nodes and their communications in the bus. Global scheduling refers to this problem of finding an assignment of the task modules to the nodes and subsequent scheduling of their executions and communications in the nodes and the bus respectively. We introduce a novel integer linear program (ILP) to derive a static global schedule for a decentralized real-time control system consisting of periodic tasks while considering the resource, the precedence and the timing constraints. The ILP has an objective function, which minimizes the maximum of all lateness[1] of the given periodic tasks . The ILP is optimal in the sense, whenever a feasible schedule exists the ILP always finds the schedule.

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1Lateness of a task is the difference between its completion time and its deadline.