

## Graphics Tools in Adagio, A Robotics Multitasking Multiprocessor Workstation

Stephen A. MacKay  
Peter P. Tanner<sup>†</sup>

Laboratory for Intelligent Systems  
National Research Council of Canada  
Ottawa, Ontario K1A 0R8 Canada.

### Abstract

The development of Adagio, a robotics simulation workstation, has involved the implementation of several techniques unique to the system. Based on the message-passing, multitasking multiprocessor realtime operating system Harmony, Adagio is programmed using a large number of cooperating tasks. Several techniques are based on the concept of a server, a task that is alone responsible for governing a scarce resource. The Graphics Server task, the Data Structure Server task, and the Tracker Server task are responsible for the management of the frame buffer, the 3D geometric data structure and the screen tracker, respectively. Each of these servers is then a separate tool necessary for the implementation of the whole system. Each runs in parallel with other tasks and can handle requests for service from any task.

### Résumé

Le développement d'Adagio, station de travail dédié à la simulation de robots, a conduit à l'implémentation de techniques originale. Basé sur le système d'opération de temps réel, multi-tâche, multi-processeur Harmony (lui-même basé sur le transfert de messages), Adagio a été programmé en utilisant un grand nombre de tâches coopérants entre-elles. Plusieurs de ces techniques sont basées sur le concept de serveur (le serveur est la seule tâche responsable d'une certaine ressource). Les tâches "Graphics Server", "Data Structure Server", et "Tracker Server" gèrent respectivement la mémoire d'image, la base de données géométriques 3D, et le curseur d'écran. Chacun de ces serveurs est donc un outil séparé, nécessaire à l'implémentation du système complet. Chacun s'exécute en parallèle avec d'autres tâches et peut gérer des demandes venant d'autres tâches.

**Keywords:** robot simulation, realtime, multitasking, multiprocessing, message passing, server task, frame buffer, windows, 3D geometric data, user interfaces, screen tracker.

<sup>†</sup> current address: Computer Graphics Laboratory  
University of Waterloo  
Waterloo, Ontario N2L 3G1 Canada.

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### Introduction

Adagio is a robotics simulation workstation currently under development at the National Research Council. The workstation, when completed, will give the user the capability of creating and manipulating 3D objects in a robot environment, of specifying the robot task, and of viewing the results of a robot simulation. As such it will certainly be usable for many other applications that can make use of a 3D window-based near realtime display with extensive interaction capabilities.

The use of the Harmony operating system, a multitasking multiprocessor realtime message-passing system, as a base, has led to different approaches to the software architecture of an interactive graphics system. This paper discusses several of these approaches.

Three servers, a Graphics Server, a Data Structure Server, and a Tracker Server follow an idea common in multitasking systems; i.e. each is solely responsible for a specific scarce resource. The Graphics Server is charged with the maintenance of the frame buffer, while the Data Structure Server maintains the 3D geometric representation of the robot and its environment. The Tracker Server communicates with the Tablet Server to provide continuous tablet tracker echoes. It is particularly well suited for a multiwindow system and provides richer user feedback than is currently available on most systems.

### Adagio Overview

#### Goals

Adagio [Tann85b] is a workstation being developed to support research in intelligent robotics. It is intended to provide a simulation facility for studies in the off-line programming of sensor-based robots. The functional requirements of providing the user with a view of the current status of the robot in its environment with near realtime updating (i.e. 5-30 frames per second), and providing for rich interactive dialogues for experiments in interactive graphics-based robot programming, led to the use of a powerful frame buffer display (in our case, an Adage 3000 graphics system) with a window-based user interface. Special software for the Adage 3000 bitslice microprocessor has been written to support multiwindow near realtime line-drawing and polygon faceted 3D renderings of a single scene.

