

RCS: A Cognitive Architecture for Intelligent Multi-Agent Systems

by
James S. Albus

Abstract

RCS (Real-time Control System) is a cognitive architecture designed to enable any level of intelligent behavior, up to and including human levels of performance. RCS was inspired 30 years ago by a theoretical model of the cerebellum, the portion of the brain responsible for fine motor coordination and control of conscious motions. It was originally designed for sensory-interactive goal-directed control of laboratory manipulators. Over three decades, it has evolved into a real-time control architecture for intelligent machine tools, factory automation systems, and intelligent autonomous vehicles.

RCS consists of a multi-layered multi-resolutional hierarchy of computational agents each containing elements of sensory processing (SP), world modeling (WM), value judgment (VJ), behavior generation (BG), and a knowledge database (KD). At the lower levels, these elements generate goal-seeking reactive behavior. At higher levels, they enable decision making, planning, and deliberative behavior. Throughout the hierarchy, interactions between SP, WM, VJ, BG, and KD enable perception, cognition, imagination, and reasoning. WM supports simulation for planning and recursive estimation and predictive filtering for perception. Interaction between SP and WM enables symbol grounding and provides semantic meaning to representations in the Knowledge Database.

The most recent version of RCS (4D/RCS) embeds elements of Dickmanns' 4-D approach to machine vision within the RCS control architecture. 4D/RCS was designed for the U.S. Army Research Lab AUTONAV and Demo III programs and has been adopted by the Army Future Combat System program for Autonomous Navigation Systems.