# Coaching Driving Skills in a Shiphandling Trainer

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The benefits of using virtual environments for training are widely accepted, but challenges remain: to provide personalized embedded instruction in addition to pure practice, to provide a level of fidelity adequate to support the instructional goals of the trainer, and to deliver these capabilities cost-effectively in order to encourage their wide-spread adoption. The COVE (Conning Officer Virtual Environment) project is addressing these challenges in the context of shiphandling training for the US Navy; in particular, it focuses on the collection of skills known as *Seaman's Eye*.

COVE combines two technologies—a virtual environment and a tutoring system.

- The COVE virtual environment replicates the visual and aural cues relied on by a Conning Officer. It simulates ship hydrodynamics, ship interaction forces, sea-keeping motions, and the look of the sea. It supports natural voice interaction between the Conning Officer and a simulated helmsman who controls the ship.

- The COVE tutoring system manages a varied curriculum of scenarios and measures each student's performance against expert levels of ability in the scenarios. It provides instruction during each practice session and offers opportunities for review and remediation afterwards. It assesses individual competencies in the skills composing Seaman's Eye.

COVE will have been under development for 18 months and is being evaluated by instructors and students at the Surface Warfare Officers School in Newport, Rhode Island. The current prototype supports underway replenishment (UNREP), an exercise in which the Conning Officer, the ship's driver, approaches and maintains his "ownship" (currently, a DDG-51 class destroyer) alongside an "oiler" (currently, an AOE-6 class supply ship) while refueling at sea. This takes place while underway at 12-15 knots with a separation of less than 100 feet. The capabilities developed for this exercise will be extended to other challenging shiphandling situations; for example, man overboard, plane guard, harbor transit, berthing, and anchoring.

These ships are big and heavy, and although they move slowly (relative to an aircraft, for example), they move inexorably. Training in Seaman's Eye and the focus of instruction in COVE is to understand the intrinsic dynamics of the ship, the perceptual cues available for tracking its movements, and the effects of commands on the control of the ship.

Training a Conning Officer also includes experience in commanding and interacting with the crew, which is done entirely through speech. COVE must teach the student appropriate orders to be given under different situations. It must also train the student to issue orders that obey the discourse conventions expected by the crew. Finally, the system must help the student learn the proper timing, type, and magnitude of orders; for example, when to slow down or to speed up, and by how much.

The key dialogue challenge for COVE is supporting a natural interaction with the simulated helmsman to control the ship, while at the same time carrying on a tutorial interaction about perceptual events, planned actions, or the results of past actions. The tutor has to know when to speak and what to say; to be helpful but unobtrusive, timely but not distracting. We take advantage of the speech conventions inherent in the domain to constrain the discourse and promote recognition.

COVE's tutoring model is based on thorough apriori analysis of the task: its intrinsic physical constraints and conventional ways of anticipating and responding to situations that arise during UNREP. An expert instructor model detects situations in which an accomplished driver would take action and uses this to guide instruction and interpret user actions (or inactions). The instruction is designed to coerce student behavior to be more like that of an expert.

Interventions are structuring around a theory of perceptual-motor behavior that presupposes a collection of parallel tasks and treats each task as a recurring process of detection, interpretation, action, and monitoring. The tutor is factored into a collection of coaches corresponding to these tasks. For example, while alongside another ship maintaining separation (side-to-side) and alignment (fore-and-aft) are the two primary tasks. Each coaching intervention focuses on some aspect of a task, starting by calling attention to the relevant perceptual cues. A policy for managing multiple coaches—and the ongoing conversation between the conning officer and the helmsman—imposes order on the output.