

IMPLEMENTATION OF PROBABILITY RAMP CONTROL SEDATION IN A HANDHELD DEVICE

Elie Sarraf, MDCM, B. Eng, Jeff E Mandel, MD, MS

Perelman School of Medicine at the University of Pennsylvania, Philadelphia, Pennsylvania

Introduction: Probability ramp control (PRC) employs pharmacokinetic/pharmacodynamics modeling to devise an infusion sequence that identifies, during a slow increment in the probability of loss of responsiveness (LOR), the effect site concentration associated with this endpoint (1). The system requires minimization of a nonlinear function to determine a bolus and two infusion rates that will track a target trajectory, and when LOR is observed, a second minimization to determine the subsequent infusion sequence. The system was originally implemented in MATLAB; the current effort describes implementation on the iPhone to permit distribution for a multicenter trial.

Methods: The mathematical core of the algorithm employs minimization of an error function derived from application of an infusion sequence to a state space model. In MATLAB, this is accomplished with built in functions; to implement in C, the GNU Scientific Library (GSL) was employed.

Two additions were made to exploit features of the iPhone – the accelerometer and voice command input/output. The accelerometer allows the iPhone to be secured in the patient’s hand and loss of consciousness detected by sudden drop. Voice input/output was implemented using the OpenEars library to permit operator interaction when the device is in the patient’s hand.

Results: The mathematical core calculations are performed in less than ten seconds on a first generation iPad. Voice commands are typically recognized on the first attempt for most speakers. Accuracy of detection of loss of motor tone is high under simulated conditions, but has not been evaluated in clinical conditions.

Discussion: Implementation of PRC in clinical practice with accurate identification of the pharmacodynamic endpoint seems feasible, but will require clinical validation.

References

1. Mandel, JE, Sarraf, E Variability of response to propofol is reduced when a clinical observation is incorporated in the control - a simulation study, *AnesthAnalg*, in press

