5.15 TASK 15
Signal Processing and Controls of Pulsed Power Systems
UCSD PI: TBD

Task 15 Technical Requirements

The LANSCE (Los Alamos Neutron Science Center) accelerator provides high energy (up to 800MeV) particle beams to user programs. The heart of the system is the LANSCE linear proton accelerator is composed of four 201.25 MHz RF (radio frequency) acceleration structures and forty four 805 MHz RF acceleration structures as well as beam transport optics system. The RF system primarily affects the longitudinal (along the major velocity direction) characteristics of the beam and the beam transport system primarily the transverse characteristics. Various model-based software tools and beam-based measurements are used to determine the system parameters of the RF and beam transport systems and, in general, the two systems are considered independent. On LANSCE the RF cavity fields are maintained to a set point by independent feedback and feed-forward control systems at each RF station and the magnet currents are controlled independently at each magnet power supply. Experience with the LANSCE accelerator has shown that the margin for error decreases when the accelerator is operating under heavy beam loading. Understanding the system sensitivity correlation and propagation function is critical to optimizing beam quality as well as system and subsystem performance and efficiency. Since the effects of perturbations may only show up at higher energies, are cumulative, and are measurable when longitudinal or transverse changes are made, a complete system analysis is necessary to truly understand the error sources.

The optimization of the LANSCE accelerator performance requires a multi-discipline analysis and modeling effort to provide a framework for the optimization of the system. Contributing elements include ion sources, RF systems, magnets and magnet power supplies, accelerating structures and particle optics systems as well as the consideration of how each effects the longitudinal and transverse beam dynamics. Current software tools focus on modeling specific aspects of the accelerator system and usually make simplifying assumptions about the other aspects. This project will encompass both the overall analysis of the system and specific subsystem analysis and involve (but not necessarily limited to) the following areas of study:

1) Beam quality optimization and control
2) RF Cavity response to external perturbation (beam) and noise
3) System characteristic fluctuation analysis
4) Data transport and analysis
5) Other aspects of system

Task 15 Deliverables

	Task 15 - Deliverables	Delivery (days after award)
9.1	Submit report summarizing a literature review focused on LANSCE accelerator papers and general papers on proton LINACS (linear accelerators)	180
9.2	Submit report summarizing a literature review focused on LLRF (low level RF), HPRF (high power RF), MPS (magnet power supply), and Injector papers - focus on learning the major hardware system.	180
9.3	Submit report summarizing a literature review that focuses on modeling technique papers – Accelerator Systems, RF Systems and Beam Dynamics. This report will focus on how people have modeled the hardware	270
9.4	Submit a letter report defining the students area of study and an outline of project that will address shortcoming identified in the literature reviews	360