

## **Salinity Sensor & Advancing Hydrological Management Project Summary**

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### **Salinity Sensor for Willapa Bay Estuary:**

We will develop an inexpensive, biologically-driven, data-logging sensor that can be used to create a salinity map of estuaries. Our understanding of physical conditions experienced by estuarine organisms, as well as circulation, flushing, and ocean-estuarine coupling, would be revolutionized through simultaneous deployment of 50-100 salinity sensors. Estuaries are sites of dramatic variation in salinity, but it is not currently possible to sample in a way that is spatially and temporally dense: logging sensors are too expensive, and cheap sensors do not log. Our sensor is not designed to achieve more accuracy or longer deployment time than commercial sensors. Rather, our objectives are to reduce costs and carry out multiple functions through a simple design. Our proposed toroidal design is innovative because the internal electronics not only measure conductivity but will also be used for programming, downloading data, charging the battery, and reducing biofouling in completely sealed units. RRF support will enable construction of 150 logging salinity sensors, which will be calibrated in the lab and field-tested in comparison with an available highly-accurate commercial device.

### **Advancing Hydrological Management in the Mekong Delta:**

#### ***Statement of Objectives for the Proposed Project***

The fertile Mekong Delta is an integral part of Vietnam's economy. It is also home to many rare species of birds, fish, mammals and unique ecosystems such as mangroves and wetlands. In the past century, the Mekong Delta has been exploited and transformed with relatively little consideration for its complex ecology and regard for long-term environmental consequences. The recent aquaculture industry boom, e.g., shrimp farming, has been perhaps the most devastating. The environmental damage caused by this intensive aquaculture in the Mekong Delta is well documented. It has led to indiscriminant chemical use and irresponsible local hydrological management practices that have accelerated environmental degradation over the past decade. Much effort by the government and NGO's has focused on educating local inhabitants of the consequences of their actions, yet, they are left with little or no concrete viable alternatives. Vietnamese scientists at Can-Tho University assessed the highest environmental priority in the Mekong Delta to be *soil acidification, salinization, nutrient degradation and pollution due to agricultural effluent*. To address these priorities, we propose strongly coupling education with providing the latest technological tools and training necessary to effectively manage the Delta's natural resources for the long-term. First, we propose a real-time hydrological monitoring and control research project to regulate the sluice gate operations. Secondly, we propose integrating this project with university education at Can-Tho University to increase awareness and research capacity in the region.

*Hydrological Monitoring:* Starting in 1994, the Vietnamese government constructed a series of sluice gates in the coastal regions of the Mekong Delta to provide better hydrological control for farmland with goals to increase rice production and to reduce seawater incursion. GIS data compiled in the late 1990's and early 2000's shows obvious improvement in land use and regional economy. Management conflicts between designated land use areas and recent evidence of environmental degradation (such as acidification, nutrient loss and pollution due to inadequate flushing) call for a better sluice gate monitoring and management scheme. We propose to implement a robust, inexpensive sensor network in the Mekong Delta to achieve real-time hydrological monitoring and management of the sluice gates using optimal control techniques.

*Educational Development:* The Mekong Delta is the "food basket" of Vietnam, yet the average education level of the Delta inhabitants is below the national average. There is a mandate from the Vietnamese government to increase the educational level and personal awareness of the Delta inhabitants. We propose to integrate university-level education development with the above-mentioned research project. We are currently working with the Mechatronics Department at Can-Tho University (CTU) in this endeavor. CTU is a land-grant model university located in the heart of the Mekong Delta that has been carefully selected by UW's NSF IGERT administrators for its open-minded approach toward research and international collaboration.

Our proposed project seeks to achieve two main goals through its implementation: (1) apply cutting edge technology toward developing specially adapted, inexpensive sensor modules that are robust in the Mekong Delta and new control engineering methodology toward optimally managing the sluice gate operations and (2) enhance the research and education infrastructure at Can-Tho University by strengthening education partnership with UW through assistance in curriculum development, workshops, and student exchanges. Metrics for successful implementation of this project will be to assess whether or not: (1) the controlled region with sluice gates has a similar ecology to an uncontrolled region with no hydrological regulation and (2) CTU becomes an effective, independent research institution in the area of mechatronics, control and automation.