BRADLEY-HERZFELD CATALYST AWARDS – SUMMER 2016

Responsive Writing Solutions ($50,000)

David Clark, Ph.D., Associate Professor, Department of English; Associate Dean, Humanities

Dr. Clark teaches and researches pedagogy, content management, and the rhetoric of technology, and has over 20 years of experience as an instructor and practitioner of technical communication. Over the past several years, he has been hired by GE Healthcare, SC Johnson, Affiliated Engineers, Inc., Affiliated Construction Services, and others to conduct workshops to help their technical staff improve their writing. Most employees in business write, whether it is emails, reports, or collaborative documents. Writing that is unclear and low in quality is expensive because it slows work flow and alienates readers. Clear, precise communication is even more critical in the growing global economy, where customers and collaborators may not be native speakers of English.

Helping "Unexpected Writers"

Dr. Clark and his team have formed a start-up company, Responsive Writing Solutions, in order to help organizatinos save time and money by providing training, support, and feedback to "unexpected writers", who are those with a technical specialty but who spend disporportionate amounts of their time writing. Throught the UW Ideadvance grant program and the NSF I-Corps local and national program, his team has conducted nearly 200 interviews with potential customers, which has lead to pivots and rethinking to develop a minimum viable product for launch. This proposed product will be Microsoft Word and browser plugins that will provide instantaneous feedback on correctness, conciseness, plain language, best practices, and company-specific standards.

Natural Language Processing and Controlled Natural Languages (CNL)

The software will draw upon CNLs which are subsets of natural languages built on restricted grammars and vocabularies. One of the most well-known CNLs in Plain English. Plain English is a restricted version of natural English designed to reduce the complexity of English communication. Individual corporations also often develop their own industry specific CNLs to avoid potential communication difficulties. Dr. Clark's software will be built on computational analysis of successful, optimized company documents, to which new documents can also be added over time for further customization. This will allow the CNL Tol evolve and grow with the company. A larege portion of the Catalyst Grant funding will be crucial for the development of the software. Responsive Writing Solutions already has test sites arranged with customers willing to help in an initial trial of the plugin.

Customer Discovery and Commercialization

Through these interviews they have found that there is indeed a need and interest in the product. The few competing products in the market have not been successful in selling to targeted customer segments. There are a handful of competing plugin and standalone products that offer writing assistance, but they are either focused on the educational market, not customizable to the specifics of individual organizations, or extremely expensive and complex. The planned sales of a plugin product should provide a scalable return on investment as well as provide opportunities to upsell training and consulting services. Best pricing is being explored, but monthy and annual subscription rates would be below the most obvious competitors. Company-wide subscriptions with a long-term license of software is another possible option.

Snapshot 3-D optical tomography ($50,000)

Yongjin Sung, Ph.D., Assistant Professor, Department of Biomedical Engineering

Dr. Yongjin Sung's lab researches challenges in optical imaging techniques applied to flow cytometry as well as imaging of high speed processes and noninvasive diagnostics. One of Dr. Sung's research objectives is to enable 3D imaging in high throughput flow cytometry. High throughput flow cytometry is a growing market with applications in pharmaceutical drug discovery and clinical diagnostics. Current high throughput 3D imaging techniques capture several hundred images by scanning cells or particles as they move. Object movement during scanning causes imaging artifacts that limit high throughput flow cytometry capabilities. A technology that reduces object movement artifacts in high throughput processing will lead to greater processing and sorting capabilities of cells, including stem cells. Dr. Sung's research on snapshot 3D optical tomography reduces object movement artifacts by capturing the several hundred images simultaneously.

Snapshot to demonstrate imaging of fast 3D dynamic process. The research proposed in the next year includes development of a functional prototype that will be used to demonstrate 3D imaging of dynamic processes important to advancing flow cytometry capabilities. Research will also be conducted on data processing and image reconstruction algorithms. Results from imaging the dynamic process will complement commercialization efforts by UWMRF. In the spring, Dr. Sung's lab plans to build a compact snapshot tomography module that may be mounted to existing microscopes and flow cytometers which may be used for further evaluation by companies interested in licensing the technology.

Customer discovery identifies opportunities across industries. Applicants were asked to apply lean launch methodology to their research to help test market hypothesizes about what value their research provides and who would benefit from it. Dr. Sung identified two potential applications, one with the Blood Research Institute for high throughput, label-free diagnostics for hematologic malignancies and the other with Nippon Electric Glass for characterization of 3D refractive index maps for developing new glass products. Generating 3D refractive index maps is an additional capability of the snapshot 3D optical tomography system and allows for direct measurement of refractive index properties of glass. Customer discovery helped identify multiple markets that may benefit from snapshot 3D optical tomography.

Snapshot Expands flow cytometry opportunity in a growing market. The utilization and number of applications for flow cytometry continues to grow with the market estimated by BCC Research to reach $6.3 billion by 2020, the 2015 market was estimated at $4.1 billion. Snapshot 3D optical tomography is situated within the hardware segment of the market which is just over half of the flow cytometry market. The flow cytometry market has largely been consolidated by Beckman Coulter and Becton Dickinson. The UWM Research Foundation has filed a provisional patent application on the snapshot 3D optical tomography technology and is exploring the commercial potential of the technology in flow cytometry applications and in 3D refractive index applications.

New Methods for Creating Sterile Grass Plants as well as Restoring Their Fertility

($35,000)

Dazhong Zhao, Ph.D., Associate Professor, Department of Biological Sciences

Dr. Zhao's lab has a long-term goal of understanding the molecular mechanisms regarding cell differentiation and plant development using molecular genetic, cell biological, and systems biology approaches. Specifically they are looking at the anther, the male part of a flower which produces pollen, to elucidate how somatic and reproductive cells differentiate. They are also studying microRNAs which have emerged as crucial regulators of gene expression, and what role they play in controlling the auxin signaling network during plant development.

Serendipitous Discovery. During their basic research on plant reproduction and development, Dr. Zhao's laboratory found that they were able to create both male and female sterile Arabadopsis and tobacco plants. They utilize the SDS::SDS-BARNASE system which can specifically ablate pollen and megaspore mother cells. Megaspore and pollen mother cells are two small groups of reproductive cells, which are differentiated after all floral organs are established. Ablating pollen and megaspore mother cells only leads to elimination of male and female gametes, but it does not affect differentiation of any other somatic cells and flower development. Use of this system, while removing gametes, does not affect plant growth rate, size, or flowering.

Restoration of Fertility. In order to restore plant fertility, the team invented the inducible artificial microRNA system which produces a microRNA that can inhibit the BARNASE expression. This microRNA essentially "turns off" SDS protein which blocks fertility to allow for pollen and seed formation. There are alternative systems used to create sterile male plants in the industry, but sterility of female plants has been difficult to achieve. In other systems often the plants are sterile, but they are smaller and the flower size is reduced. The restoration of fertility is important in the industry for genetically modified (GM) plants. Completely abolishing both male and female (bisexual) fertility is the only fail-safe way to prevent transgene flow; however, approaches for generating bisexual sterility are limited.

Market and Commercialization Opportunities.

Since genetically modified (GM) plants were produced in 1983, the number of GM plants has been rapidly increasing yearly. For monocot grasses, transgenic approaches have been used to improve digestibility and resistances to abiotic and biotic stresses, such as drought, salt and cold. Recent studies show that GM switchgrass has reduced lignin content, improved forage quality, and increased biomass and cellulosic ethanol production. Besides traditional uses of grasses, many grass species can provide a large and sustainable cellulosic biomass feedstock. Recently, switchgrass was selected as a biomass feedstock for renewable bioenergy by the U.S. Department of Energy (DOE) Bioenergy Feedstock Development Program since its broad adaption, high yield, and minimal agricultural inputs. Approval for commercial uses of GM plants is subject to complicated and stringent government regulations due to economic, politic, or social concerns over potential ecological effects of transgene flow. Transgene flow from GM plants to non-GM plants and wild relatives is mainly mediated by dispersal of pollen and seeds. Transgenes have been detected in native crop populations of maize, soybean, wheat, and canola. Most of the important forage, turf, and bioenergy grasses can be readily pollinated with wild relatives. In 2003, studies found that the pollen-mediated gene flow from GM Roundup Ready creeping bentgrass occurred within 2 to 21 km. Only through both male and female sterility can this GM gene flow be prevented.

Project Deliverables

Dr. Zhao's group plans to utilize the SDS BARNASE system in a model switchgrass system to create bisexually sterile plants. This system could be of great use to the biofuel industry as most plants grown for biofuels are modified for greater ethanol production. With increasing government regulations for GM plants, we expect this system will be of great interest to many industries both for biofuels and edible crops. A second objective is to create plants that are only male sterile. In speaking with Monsanto about this technology, they expressed an interest in male only sterile crops as well as a higher level of fertility restoration using an agent that is safe for field workers to spray. For companies like Monsanto, male only sterile crops are sufficient for their use, but current methods are difficult to execute. Dr. Zhao proposes an ethanol induction system to restore the fertility of the sterile plants to more than a 50% level of restoration of seed. Converting cellulose into cellulosic ethanol at a low cost holds the promise to find the solution for energy crisis. The cost can be significantly further decreased for cellulosic ethanol production if we produce GM perennial grasses that are highly digestible by the currently used enzymes.