The materials science and engineering of optical nonlinearities and their mitigation in high power lasers

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Abstract: Continued progress in the development of optical fiber-based lasers has led to the present state where further improvements in performance are limited by intrinsic optical nonlinearities. In order to manage such limitations, laser designers have largely adopted the approach of microstructuring the fiber to shift nonlinear thresholds to high optical powers. The nonlinearities are accepted as fixed and performance is enhanced through fiber geometric complexity. This talk treats a different option, which is to mitigate optical nonlinearities at their fundamental origin: the materials with which the light interacts. This work provides a road-map for the development of simple core/clad optical fibers whose enhanced performance – in particular, marked reductions in optical nonlinearities – is achieved materially and not through the more conventional present routes of geometrically complex fiber design. More specifically, the material properties that give rise to Brillouin, Raman, and Rayleigh scattering, transverse mode instabilities (TMI), and n2-mediated nonlinear effects are compiled and results on a wide range of optical fibers are discussed with a focus on trends in performance with glass composition. Further, optical power scaling estimations as well as binary and ternary property diagrams associated with Rayleigh scattering, the Brillouin gain coefficient (BGC) and the thermo-optic coefficient (dn/dT) are developed and employed to graphically represent general trends with composition along with compositional targets for a single intrinsically low nonlinearity, silica-based optical fiber that can achieve the power-scaling goals of future high energy fiber laser applications.
Biosketch John Ballato received the B.S. degree in ceramic science and engineering and the Ph.D. degree in ceramic and materials engineering, both from Rutgers, The State University of New Jersey, New Brunswick, NJ, USA, in 1993 and 1997, respectively. He is currently a Professor of materials science and engineering at Clemson University, Clemson, SC, USA, where he is the inaugural holder of the Sirrine Endowed Chair. He has published 400 technical papers and holds 34 U.S. and foreign patents. Among numerous other honors, his collaborative work on Anderson-localizing optical fiber was chosen as one of the Physics World’s Top Ten Breakthroughs for 2014. He is a Fellow of the Optical Society of America (OSA), the International Society of Optical Engineering (SPIE), the Institute of Electrical and Electronics Engineers (IEEE), and the American Ceramic Society (ACerS), as well as an elected member of the World Academy of Ceramics and the U.S. National Academy of Inventors.
DEPARTMENT OF INDUSTRIAL AND SYSTEMS ENGINEERING SEMINAR

On the (Distributed) Computation of Approximate Wasserstein Barycenters

Cesar Uribe
Postdoctoral Associate
Massachusetts Institute of Technology-MIT

Tuesday, April 30, 2019
10:00am – 11:00am
CII 5003

(The public is invited to attend. Refreshment will be served)

Abstract:
We study the complexity of approximating Wasserstein barycenters of $m$ discrete measures, or histograms of size $n$ by contrasting two alternative approaches, both using entropic regularization. The first approach is based on the Iterative Bregman Projections (IBP) algorithm for which our novel analysis gives a complexity bound proportional to $mn^2/\epsilon^2$ to approximate the original non-regularized barycenter. Using an alternative accelerated-gradient-descent-based approach, we obtain a complexity proportional to $mn^2/\epsilon$. As a byproduct, we show that the regularization parameter in both approaches must be proportional to $\epsilon$, which causes instability of both algorithms when the desired accuracy is high. To overcome this issue, we propose a novel proximal-IBP algorithm, which can be seen as a proximal gradient method, which uses IBP on each iteration to make a proximal step. We also consider the question of scalability of these algorithms using approaches from distributed optimization and show that the first algorithm can be implemented in a centralized distributed setting (master/slave), while the second one is amenable to a more general decentralized distributed setting with an arbitrary network topology.

Bio:
Cesar A. Uribe received the M.Sc. degrees in systems and control from Delft University of Technology, in The Netherlands, and in applied mathematics from the University of Illinois at Urbana-Champaign, in 2013 and 2016, respectively. He also received the PhD degree in electrical and computer engineering at the University of Illinois at Urbana-Champaign in 2018. He is currently a Postdoctoral Associate in the Laboratory for Information and Decision Systems-LIDS at the Massachusetts Institute of Technology-MIT. His research interests include distributed learning and optimization, decentralized control, algorithm analysis, and computational optimal transport.
“CAR T Cell Therapy Manufacturing: Delivering on the Promise of a Transformational Therapy”

Abstract

CAR-T cells have been proven clinically to be life-saving therapies for a number of hematological cancers, and offer further promise for additional hematological indications as well as for solid tumors. Commercializing these CAR-T therapies offers numerous challenges in all areas of drug development, including manufacturing and supply chain. Raw material procurement, patient tracking, cost-effective and robust manufacturing, process changes and comparability, process and assay validation, QC/QA release, manufacturing facility strategies, staffing models, and cold supply chain are among the many technical challenges that will be discussed in this presentation.

Biography

Gregory Russotti is currently Vice President of Cell Therapy Technical Development at Celgene Corporation, responsible for process development, analytical method development, product sciences and process/assay support for clinical and commercial manufacturing for cell therapy products. Prior to joining Celgene in 2006, Greg spent 15 years at Merck Research Laboratories developing products that included live virus vaccines, monoclonal antibodies, recombinant vaccines, and microbially-produced natural products. He worked on development, scale-up, and tech transfer of cell culture, microbial fermentation, and downstream isolation processes to clinical and commercial manufacturing facilities. Greg received his B.S. and M.S. degrees in Chemical Engineering from Rensselaer Polytechnic Institute and his Ph.D. in Chemical and Biochemical Engineering from Rutgers University.

Refreshments: 8:30 a.m., CBIS Gallery
Bidirectional Attentive Memory Networks for Question Answering over Knowledge Bases

Thursday, May 2, 2019
4:00 PM EDT / 2000 GMT
https://ibm.webex.com/join/aihn

Speaker: Yu (Hugo) Chen
RPI

When answering natural language questions over knowledge bases (KBs), different question components and KB aspects play different roles. However, most existing embedding-based methods for knowledge base question answering (KBQA) ignore the subtle inter-relationships between the question and the KB (e.g., entity types, relation paths and context). In this work, we propose to directly model the two-way flow of interactions between the questions and the KB via a novel Bidirectional Attentive Memory Network, called BAMNet. Requiring no external resources and only very few hand-crafted features, on the WebQuestions benchmark, our method significantly outperforms existing information-retrieval based methods, and remains competitive with (hand-crafted) semantic parsing based methods. Also, since we use attention mechanisms, our method offers better interpretability compared to other baselines.

from NAACL 2019

Bio Hugo is a fourth year PhD student in the Computer Science Department of Rensselaer Polytechnic Institute. His advisor is Prof. Mohammed J. Zaki. He is also closely working with Dr. Lingfei Wu from IBM Research. He has broad research interests in Machine Learning, Data Mining and their applications in Natural Language Processing. His thesis topic is on designing and developing novel deep learning approaches for knowledge-based and conversational question answering.

IBM Research