From September 2010 to June 2011, as a visiting professor, I was on sabbatical at NTT Photonics Laboratories in Japan. NTT Photonics Lab is a world leading institution in photonics and optoelectronics research. Based on the company’s request, I was doing research on quantum cascade laser modeling and DFB laser parameter extraction. With the help of the Photonics Lab director Dr. Enoki and my collaborators Dr. Fujisawa and Dr. Yamanaka, I was also arranged to visit five most advanced research groups at NTT. Although my sabbatical was disrupted by the earthquake, the achievement was phenomenal. I presented two research seminars (lectures) on Monte Carlo Simulation of carrier transport in nanostructure, and Monte Carlo method on DFB laser parameter extraction, respectively. For the first time, I applied the Monte Carlo method to the DFB laser parameter extraction application. The research led to one NTT Technical Report and two computer simulation packages for the company. Now I am working on the research paper submission and continued collaborative research proposals. I also incorporated some advanced research topics into a senior Engineering Physics course to make students familiar with the contemporary technology. Attached are the research report and the first research seminar presentation.

NOTE: The research report is classified as confidential document by NTT Photonics Laboratories. Please don’t make this report accessible to the public.
Quantum Cascade Laser Modeling and Simulation

and

DFB Laser Diode Parameter Extraction

Wei Li
Dept. of Engineering Physics, University of Wisconsin, Platteville, WI, USA

Takeshi Fujisawa, Takayuki Yamanaka and Fumiyoshi Kano
NTT Photonics Laboratories, Atsugi, Kanagawa, Japan
Preface

In this report, we summarized the research results of two projects on (1) quantum cascade laser modeling and simulation, and (2) DFB laser diode parameter extraction. We investigated these two independent topics using a similar approach: the Monte Carlo method. Some results and algorithms are very interesting and original. The research achievement will lead to several publications in the near future. It should be noted that in this report, we didn’t present the history background or review of the research development. Therefore, our literature references are incomplete. For example, some milestone papers are not included in the reference list. Instead, we only gave the key information in order to develop the model, assuming the readers are familiar with the research topics. We tried to make the formulations complete and self-contained. With this report, the readers can easily follow the simulation procedures. The report can be used as a simulation implementation manual. Because of the March 11 earthquake, the projects had to be terminated earlier. This report also provides a clear road-map for future continued researches and collaborations.

Acknowledgements from Dr. Wei Li: NTT Photonics Laboratories provided a great opportunity for me to work with the leading scientists and engineers in the world, learn the development of state-of-the-art technology, and experience the attractive and unique Japanese culture. I benefited a lot from the technical collaboration with Dr. Fujisawa, Dr. Yamanaka and Dr. Kano. Besides the collaborators, I also had a lot of interesting discussions on long wavelength laser diode with Dr. Mitsuhara. I want to thank Dr. Takahata for helping measure some DFB spectra. I greatly acknowledge the kindness and support from the leaders and staffs of the Department and Division, Dr. Oohashi, Dr. Ito, Dr. Inoue, Dr. Enoki, Ms. Watari and Ms. Kotake. I own a lot to Dr. Fujisawa, who took care of me on everything during my stay in Japan. I want to thank Dr. Akage and his family for sight-seeing activities in the weekends. Dr. Yamanaka and his wife’s great help after the earthquake always makes me and my family deeply moved and thankful. Finally, I would like to express my sincere gratitude to all the people in our lab, who made me feel like home. I really enjoy my sabbatical at NTT.