THE EDUCATION UNIVERSITY OF HONG KONG

FACULTY OF LIBERAL ARTS AND SOCIAL SCIENCES

Research Output/Impact/Knowledge Transfer Prize
for the Dean's Research Fund 2018-19

Brief Introduction of Awardee's
Research/KT Publication/Study/Output and Future Research/KT Development

Awardee (Dept):	Dr. Yeung Chi Ho Bill, Associate Professor (SES)
Publication Title/KT project:	Entropy Inflection and Invisible Low-Energy State: Defensive Alliance Example

A. *Briefly introduce your research/KT publication/study/output for which you have received the prize.*

The publication describes a finding which is in contrast to a common belief in statistical physics relating energy and states of physical systems. This common belief has been widely accepted across the physics and other related research communities, and has been applied in other disciplines to derive optimization algorithms. Therefore, the findings in this publication has important implications on our fundamental understanding of statistical physics, as well as the design of existing and future optimization algorithms which are used in interdisciplinary research areas including physics, applied mathematics and computer science.

Specifically, the understanding that a lower system temperature leads to a higher probability of visiting low-energy states is fundamental in statistical physics and gave rise to optimization algorithms such as the simulated annealing (SA), which is commonly-used across disciplines. We demonstrate that this is not always the case through the exemplar optimization problem of strong defensive alliance, where the entropy-energy curve exhibits an inflection point that corresponds to a specific system temperature; lowering the temperature further does not result in lower-energy solutions. This has a wide-range of implications on the use of SA in both physical systems (e.g., certain sparse Ising models) and hard-computational tasks (e.g. diversity coloring). This fundamental work is therefore of interest to physicists, computer scientists and other researchers who use SA for optimization.

B. How you used/will use your prize and perhaps its usefulness to your research/KT development?

The funding allocated by the prize will be used to support research assistants to continue research in related directions, to further understand physical systems and optimization problems with similar phenomenon, and to explore applications in terms of optimization algorithms which utilize this enhanced understanding.

C. Expected research/KT outcomes/outputs/impacts arising from this prize.

The new findings and understanding obtained will be crucial to the progress of related research projects; these findings will be disseminated through different channels including journal publications and conference presentations.