

[Grant - in - Aid for Scientific Research on Innovative Areas(Research in a proposed research area)]
Interdisciplinary Area



Title of Project : Conquering Cancer through Neo-dimensional Systems Understanding

Satoru Miyano
(The University of Tokyo, The Institute of Medical Science,
Professor)

Research Project Number : 15H05907 Researcher Number : 50128104

【Purpose of the Research Project】

We will deepen our integrative systems understanding of cancer by investigating genesis, evolution and heterogeneity of cancer, genetic diversity in an individual due to mosaicism of embryonic/somatic cells, unknown functions of non-coding RNAs, and malignancy in regard to cellular context. “Systems Cancer Research” utilized methodologies such as mathematical modeling, large-scale data analysis, and statistical genetics enhanced with supercomputers as the driving force. By newly integrating an innovative information technology “Cognitive Computing” into cancer research, “Systems Cancer in Neo-dimension” will achieve a new paradigm for shuttling skillfully between the targets of interest in individual cancer and the entire pictures of cancer unraveled with the systems cancer research methodologies. Simultaneously, we establish the cancer ELSI that will ensure consistency with not-yet encountered issues springing out from big data, and bolster, sometimes face off against, currently inconceivable future cancer genome research and medicine.

【Content of the Research Project】

We develop methodologies for acquiring large-scale precise global views of systems disorders in cancer and then pinpointing target parts of interest (genes, pathways, etc.) by cognitive computing utilizing cancer big data.

[A01] New challenges of integrative systems understanding of cancer

The first issue is “global view on whole-genomes of human populations” in disease-wise or population-wise way based on large-scale omics data and phenome data. The second issue is “local view on genomes” for understanding the functions of cancer genomes. We deepen our understanding of systems disorders in cancer by integrating these two issues with the innovation in genome analysis and supercomputer ability. We investigate cancer systems spatiotemporally and/or topologically from the viewpoints of cellular context, evolution and heterogeneity, and non-coding RNA, that shall lead to innovations for prevention, early-diagnosis, therapeutics, and escape from resistance of therapy.

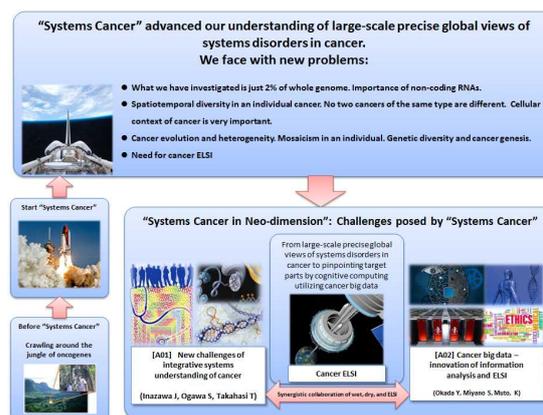


Fig. 1 Overview of Research

[A02] Cancer big data – innovation of information analysis and ELSI

We develop a framework for mathematical methods (mathematical modelling, data analysis, statistical genetics, etc.) to encounter with cancer big data. Innovative information technologies such as “Cognitive Computing” will be exploited to advance integrative systems understanding of cancer. [A1] will produce personal whole genomes and will unravel mosaicism in cells and how mutations in hematopoietic stem cell are accumulated by aging. To cope with the emergency of cancer big data society, we establish a new cancer ELSI.

【Expected Research Achievements and Scientific Significance】

We can advance systems understanding of heterogeneity and complexity of cancer in terms of genomes, non-coding RNAs, and cellular context of cancer together with innovative analytics. Applications of cognitive computing to cancer analytics will lead to an innovation, and the establishment of cancer ELSI will have an increasing impact over the aging society.

【Key Words】

Systems Cancer Research: An interdisciplinary field to understand cancer as system disease by combining mathematical modeling/simulation, large-scale data analysis and experimental systems analysis.

【Term of Project】 FY2015-2019

【Budget Allocation】 1,101,600 Thousand Yen

【Homepage Address and Other Contact Information】 <http://neosystemscancer.hgc.jp/en/>