Results on research activity（Akio Kawauchi）

My early work includes a positive solution to the non-invertibility problem of knot 8_{17}, known as the R. H. Fox problem, which remained unsolved for 50 years after it was posed in J. W. Alexander's knot classification. There are also earlier works on quadratic forms of 3-manifolds, descriptions of surfaces in the 4-space (with T. Shibuya and S. Suzuki), and proposals for unknotted surfaces in the 4-space (with F. Hosokawa). I started a joint seminar "KOOK seminar". Under co-operations with KOOK Seminar members, "Knot Theory" (Springer Verlag Tokyo, 1990) was published in Japanese as the first book on the whole knot theory in Japan. Later, English version “A Survey of Knot Theory” was published abroad (Birkhäuser, 1996), appearing that it influences researchers of knot theory around the world. I studied analogous structures and flexibilities of the topology of given 3-manifolds and links as topological imitations, led to the solutions of Simon-Wolcott conjecture and Reni-Meccia-Zimmerman conjecture. I studied complete (but hard to calculate) invariants characterizing closed orientable 3-manifolds. The first paper is written by myself, and the other papers except for a joint paper with Tayama and B. Burton are written as joint works with I. Tayama. By developing this idea, the set of closed orientable 3-manifolds could be described as a real analytic function and (by a joint work with Tayama) as a complex analytic function. As scientific applications of knot theory and topology, there are papers with the following topics: “Knot model in psychology”, “Constructing tangle models of prion proteins relating to Amyloid β” (a joint work with K. Yoshida), “Spatial graphs applying string-shaped materials”, “Complexities of knitting patterns”, and “Knotting probabilities of spatial arcs”. As another work, there are papers on classifying 4D universe with every closed orientable 3-manifold embedded. As books in Japanese, “From linear algebra to homology”, “Lecture on knot theory” and “Theory of knots” are written by myself, and “Knot Theory and Game” is written with A Shimizu and K. Kishimoto in relation to the game “Region Select” applying knot theory jointly developed and shown at the world same time in the Android market with two related patents. From April 2003 to March 2008, I was a program leader of the 21st COE program “Constitution of wide-angle mathematical basis focused on knots”, leading to establish Osaka City University Advanced Mathematical Institute (now Osaka Central University Advanced Mathematical Institute). In cooperation with the knot educational research group of Osaka Kyoiku University introducing knot theory to school students, the book “Teaching and learning of knot theory in school mathematics” was published as co-editor with T. Yanagimoto. In recent years, I have succeeded in interpreting 3D objects as 4D objects through ribbon surface-links. This has enabled me to solve some more or less interrelated problems, such as the triviality conjecture for surface-links, the 3D and 4D smooth Poincaré conjectures, J. H. C. Whitehead's aspherical conjecture, Kervaire's conjecture for group weights, and the slice-ribbon problem on classical links. I have published a series of papers on these topics, and am currently doing further related research.