

## Research Plan

Based on the theory of algebraic analysis and methods of computer algebra, I investigate complex analytic properties of singularities. By developing mathematical analysis in a constructive manner, I want to elucidate the true nature of various phenomenon.

### **I. Algebraic analysis and computational complex analysis of non-isolated singularities**

(i) I consider hypersurface with non-isolated (higher dimensional) singularities and, by utilizing the concept of Groebner bases of PBW algebras and the concept of Neoter operators for local cohomology classes associated with a primary ideal, I investigate b-functions and the structure of the relevant holonomic D-modules. I study Lagrangian cycles, the monodromy structure of vanishing cycles, microlocal b-functions. By analyzing polar varieties, I clarify the relation with Le cycles due to D. Massey.

(ii) By analyzing the deformation of holonomic D-modules associated with a deformation of singularities, I investigate equisingularity problems.

(iii) By using the holonomic D-modules associated to holomorphic map germs, I study complex analytic properties of map germs. As applications, I shall study the relationship between invariants introduced by D. Mond and that of holonomic D-modules.

### **2. Computational algebraic analysis of higher order Kashiwara operators and a study of multiplier ideals**

(i) It is known that the concept of b-functions is closely related with multiplier ideals and Hodge ideals. Whereas, even for the case of isolated singularity, it is in general quite difficult to compute since the cost of computation of Groebner basis of s-parametric annihilators by existing methods is quite high. I construct a new effective algorithm for computing Kashiwara operators in order to compute b-functions. By using these results, I investigate mathematical structure behind subtle properties of b-functions.

(ii) I shall investigate, in collaboration with experts on algebraic geometry, relation between b-functions and multiplier ideals by using local cohomology to design a new method for computing multiplier ideals.

### **3. Computational complex analysis of indices of singular holomorphic foliations**

Lehmann-Suwa index is a natural extension of the Camacho-Sad index to the case of a holomorphic foliation along a complete intersection with an isolated singularity. It is an important complex analytic invariant whereas it is difficult to compute by using existing methods. I shall construct, in collaboration with experts on foliation, a new method for computing Lehmann-Suwa indices and study their mathematical properties.

### **5. Study of Waring problems via a symbolic generalized eigenvector method**

The Waring problem for polynomials is an important problem related with the tensor decomposition problem. By taking results of J. Brachat, Pierre Comon, B. Mourrain and E. Tsigaridas and a recent results of A. Bernardi and D. Taufe into consideration, I shall study cuctas ranks associated to the tangential variety of Veronese variety by using the symbolic generalized eigenvector method.