My main results on study of the differential geometry

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For eigenvalue problems of differential operators on Riemannian manifolds

1. For the eigenvalue problem of Laplacian, in my joint works with professor Yang, we studied universal inequalities on eigenvalues and obtained optimal universal inequalities. By making use of our universal inequalities, we extended the famous inequalities of eigenvalues of Laplacian in bounded domain in Euclidean spaces by Li-Yau to the general Riemannian manifolds. We resolved a problem on eigenvalues that was proposed by I. Chavel in his famous book: Eigenvalues in Riemannian geometry. In my joint work with professor Yang, we obtained a recursion formula by a new strategy and by making use of the recursion formula, we proved that all eigenvalues can be bounded from above by the first eigenvalue. In 2016, professor M. S. Ashbaugh said in his talk and written in his paper that Cheng and Yang made the great strides in the fields, in what amounted to a tour de force.

2. For eigenvalues of the buckling problem, famous mathematicians in the world, Payne, Polya and Weinberger, in 1955, proposed whether it is possible to obtain universal inequalities for eigenvalues? This problem was a very hard problem. Up until 2006, there were no any developments. In my joint work with professor Yang, we resolved this famous and hard problem.

3. For eigenvalues of the clamped plate problem, I and Yang resolved a problem on universal inequalities proposed by professor M. S. Ashbaugh

For study on geometry of hypersurfaces

1. For S.S. Chern conjecture on compact minimal hypersurfaces in the unit sphere with constant scalar curvature, we obtained the important results.

2. For complete self-shrinkers of mean curvature flow, we proved the existence of the second gap of the squared norm of the second fundamental form and we completely classified complete self-shrinkers in R^3 if the squared norm of the second fundamental form is constant.

3. We introduced the concept of λ-hypersurface and constructed embedded λ-spheres which are not the round sphere.