Preface

This special issue of *Advances in Applied Clifford Algebras* is dedicated to Professor Klaus Gürlebeck on the occasion of his 60th birthday, for his achievements in mathematics and its applications.

Klaus Gürlebeck was born on October 3, 1954, in Prenzlau (Germany). He received his degree in mathematics (Diplommathematiker) from the TU Karl-Marx-Stadt in the former GDR in 1980 with the rating “Excellent”. He obtained his PhD in 1985 at the same University (now Chemnitz University of Technology) under the supervision of W. Sprößig. After holding several positions in Karl-Marx-Stadt (now Chemnitz) he joined the Bauhaus University of Weimar in 1995, where he became Universitätsprofessor (Full Professor) in Applied Mathematics in 1999.

Klaus Gürlebeck has authored or co-authored 6 monographs and more than 130 research articles, sections in books and conference contributions on topics such as quaternionic analysis, Clifford analysis, numerical mathematics, parameter identification problems, fluid mechanics, and elasticity theory. He has supervised and co-supervised 14 doctoral students originating from different countries. Moreover he has collaborated with many mathematicians all around the world and received research funding awards by agencies from Germany and abroad.

Klaus Gürlebeck is particularly well known for his pioneering work in discrete quaternionic analysis, in hypercomplex decomposition methods, and in construction methods for Clifford holomorphic complete polynomial systems. Together with W. Sprößig he developed a new strategy for solving boundary value problems in bounded domains in R^3 by the presentation of a complete hypercomplex solution theory including both analytical and numerical research. In 1989, as a consequence of this work, the first monograph on “Quaternionic Analysis and Elliptic Boundary Value Problems” was published.

In 1994 H. Malonek invited him to Aveiro, and since then, Klaus Gürlebeck has been in close contact and cooperation with Portuguese mathematicians. He worked together with H. Malonek, I. Cação, J. Morais, I. Falcão, P. Cerejeiras, U. Kähler, and other young scientists.

In his approach to discrete quaternionic analysis Klaus Gürlebeck used the concept of the discrete fundamental solutions which play an essential role

for the construction of a discrete Borel-Pompeiu formula. Such type of formulae do not appear in the earlier two-dimensional work of R.J. Duffin, J. Ferrand, S. Hayabara, C.R. Deeter, M.E. Lord et al. He was able to master the main difficulty of finding a suitable discrete quaternionic analogue to the Cauchy operator by introducing a skillful definition of a “discrete” boundary. This seminal work has inspired further research in discrete hypercomplex analysis by several authors such as N. Faustino, F. Sommen, A. Hommel, O. Suzuki et al. Because of better physical interpretations Klaus Gürlebeck studied systems of functions defined by shifting the fundamental solution of the Dirac operator. These functions can be used for bounded and unbounded domains. The latter topics mainly determined the contents of his second monograph (co-authored by W. Sprössig) “Quaternionic and Clifford Calculus for Physicists and Engineers”, whose results have been applied to fluid mechanics problems, elasticity theory and Maxwell equations. This book is held by 831 WorldCat member libraries.

About 15 years ago Klaus Gürlebeck started his collaboration with the Chinese mathematicians Zhang Zhongxiang and Du Jinyuan from Wuhan University. Several papers on Riemann boundary value problems in Clifford Analysis appeared. In the 1990s a very fruitful cooperation began also with several colleagues from Mexico, such as M. Shapiro, L. Resendis, L.M. Tovar, L. Traversoni, and V.V. Kravchenko. This was the time when Klaus Gürlebeck became interested in the study of different spaces of hyperholomorphic functions. Together with El Sayed, L.M. Tovar, K. Avetysian, L. Resendis, H. Malonek, and S. Bernstein he studied important properties of the Q_p -scale of hyperholomorphic spaces (including Bloch and Dirichlet spaces) as well as weighted Hardy spaces.

Extending the quaternionic operator calculus Klaus Gürlebeck studied together with U. Kähler, M. Shapiro, and W. Sprössig the hypercomplex Π -operators, which above all play an important role in the treatment of the generalized Beltrami equation. Together with H. Malonek and I. Falcão he used one of the generalized Π -operators in order to give an explicit description of the Bergman kernel in hyperholomorphic function theory. Later on, he considered Bergman kernels for special geometries, in cooperation with R.S. Kraussnar, U. Kähler and P. Cerejeiras.

In recent years Klaus Gürlebeck contributed together with S. Bock, J. Morais, R. Delanghe, and R. Lavicka to the construction and application of complete orthogonal hyperholomorphic, respectively monogenic, polynomial systems in R^3 and R^4 which have Appell properties. Thereby the study of sequences of Appell polynomials initiated by H. Malonek, I. Falcão, and I. Cação could be generalized to the case of orthogonal polynomials. Having studied Physics and Mathematics in Jena, his son Norman also published a contribution to this field as result of his B.Sc. in Mathematics. In the framework of these studies also higher-dimensional Hadamard’s real part theorem

and Bohr type theorems could be proved in co-authorship of Klaus Gürlebeck and J. Morais.

In order to disseminate hypercomplex methods, Klaus Gürlebeck co-authored (together with Klaus Habetha and Wolfgang Sprössig) the textbook “Holomorphic Functions in the Plane and n -dimensional Space” (Birkhäuser, 2008; German version in 2006). In parallel with his research in quaternionic and Clifford analysis Klaus Gürlebeck is also involved in real-world applications such as the computation of flow fields in the upwind power plants (with H. Pastohr and O. Konradt), the elasticity theory for materials with cracks (with D. Legatiuk), and the spatial generalization of the famous Kolosov-Muskhelishvili formulae (with S. Bock).

Since 10 years he has co-organized the “Symposium Clifford Analysis and Applications” within the annual ICNAAM conference series. Moreover, Klaus Gürlebeck was the organiser of the 9th ICCA (International Conference on Clifford Algebras and Applications) in 2011. Klaus Gürlebeck belongs to the Scientific Board of several international mathematical journals (Mathematical Methods in the Applied Sciences, Computational Methods and Function Theory, Complex Analysis and Operator Theory).

As the representative of Thuringia of the German Association of University Professors Klaus Gürlebeck makes an important contribution to strengthening the rights of university professors in Germany.

It is for us a great honor and a real pleasure to be able to dedicate this special issue to Klaus Gürlebeck, not only for all his scientific contributions and his role in the scientific community, but also for combining his scientific skills with an amazing and contagious way of always looking at the bright side of life.

Helmuth R. Malonek
Wolfgang Sprössig

Klaus Gürlebeck