Manfred Husty: A Short Biography of his Scientific Life

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Abstract. Professor Manfred L. Husty attains the age of 65 in June 2019, which is also the age of his retirement from the University of Innsbruck. This brief biography is intended to highlight his achievements and impact in the area of geometry and kinematics.

Keywords: Manfred Husty, scientific life, short biography

1 Early Life and Education

Professor Manfred L. Husty was born on June 15th, 1954 in Hallein, a small town south of the city Salzburg in Austria. He attended the primary school and gymnasium there and graduated in 1972. In the same year he enrolled at the Karl-Franzens-University Graz and at the Graz University of Technology. His subjects were mathematics, geometry and physical education to become a high school teacher. In addition Manfred also took courses in philosophy and sociology. Still as a student, he obtained the national trainer diploma for track and field coaches. Manfred received his magister degree in December 1979 and finished his doctorate at Graz Univesity of Technology in December 1983. His thesis "Zur Schraubung des Flaggenraums" ("On Helical Motions in Flag Space") [4, 5] already deals with a topic of kinematics although in a non-Euclidean space. This direction of research can certainly be attributed to his advisor, Hans Vogler, who also made other substantial contributions to theoretical kinematics and kinematical geometry. It is safe to assume that Manfred got acquainted with some classical problems and topics of kinematics already as a student. In particular, motions with many planar or spherical trajectories were on the research agenda at the Department of Geometry in Graz at that time and certainly stirred Manfred's interest, see [35] and the later summary [36].

2 Professional Career

Manfred's professional life as a kinematician and geometrician can be divided into two parts. He spent the first twenty years in academia at the Montanuniversität Leoben and the last twenty years at the University of Innsbruck.

T. Uhl (ed.), *Advances in Mechanism and Machine Science*,
Mechanisms and Machine Science 73,
https://doi.org/10.1007/978-3-030-20131-9_41

Fig. 1. Manfred Husty and Otto Röschel during a conference in Rein (1983)

2.1 Montanuniversität Leoben (and McGill University Montreal)

In October 1979 Manfred joined the Department of Mathematics and Applied Geometry at Montanuniversität Leoben, first as teaching assistant, then contract assistant, university assistant and after habilitation in March 1989 as assistant professor.

In his early career research, Manfred's work was already dedicated partly to kinematics, but mainly in non-Euclidean geometries [4, 6–8, 19, 21, 22] – obviously a fashionable topic in Austrian geometry at that time. This work culminated in his habilitation thesis "Kinematik winkeltreuer Ähnlichkeiten der isotropen Ebene" ("Kinematics of angle-preserving similarities in the isotropic plane") [9].

In spite of his classical and rather theoretical background Manfred was also interested in applications, something he could not easily find in Leoben. A turning point in Manfred's scientific carreer was the opportunity for a research sabbatical at McGill University in Montreal, Canada, which was supported by an Erwin Schrödinger Fellowship (a highly renowned grant by the Austrian Science Foundation FWF) and a visiting scholar grant by Canada's Natural Sciences and Engineering Research Council (NSERC).

This research stay in 1993/94 was initiated by a visit to Professor Andrew Samuels together with Paul Zsombor-Murray during the 5th International Conference on Engineering Computer Graphics and Descriptive Geometry 1992 in Melbourne, Australia. Manfred and Paul asked about important problems in kinematics still outstanding. One of the suggestions was the direct kinematics of general Stewart-Gough platforms – indeed a milestone problem of robotics and scrutinized by several research groups in the early 1990s. Both had the feel-

ing that this could be a problem to work on during Manfred's stay at McGill University. It turned out to be more difficult than assumed but an ingenious idea of Manfred simplified the formulas enough to be solvable by then available computer power. Manfred could compute a univariate polynomial of degree 40 that gives rise to all solutions [10].

This article is nowadays among the ten most cited articles of Mechanism and Machine Theory ever. It features, for the first time, some characteristic and dominant research techniques. To begin with, it is rooted in education at Graz University of Technology and the classic Borel-Bricard problem on motions with many spherical trajectories. Secondly, Manfred combined the classic kinematic mapping due to Eduard Study [33, 34] with geometric knowledge and intuition and methods of computational algebraic geometry in order to solve equation systems that had hitherto been completely hopeless.

Having returned from Montreal, Manfred more or less abandoned non-Euclidean kinematics in favor of problems in robotics and Euclidean kinematics. This period also marks a long-lasting collaboration with Adolf Karger from Charles University in Prague [11–17, 23–27]. Husty and Karger manifested their reputation as experts on Stewart-Gough platforms and in particular on their self-motions. This is a difficult but highly relevant topic that is still being researched nowadays. Their insights revolutionized our picture of hexapod platforms and their possible self-motion and motivated the development of software tools (for example some features of Bertini [1]) to detect them. Another noteworthy achievement of that time is the book [18], nowadays a standard textbook on kinematics and robotics in German speaking countries.

In 1997 Manfred became associate professor at Montantuniversität Leoben and had visiting positions at the University of Innsbruck, Graz University of Technology and Technical University of Dresden before he became full professor of geometry at the University of Innsbruck in 2000.

2.2 University of Innsbruck

The beginning of Manfred's work at the University of Innsbruck saw substantial changes in the geometry education. He transferred the elaborate didactic concepts of his predecessor Josef P. Tschupik to modern times and made computers and CAD systems a standard tool in geometry for engineering students. Over the years Manfred has developed and taught numerous courses on basic (descriptive) geometry for engineers, geometric modeling, visualization and CAD, mathematical background of geometry, introduction to scientific working as well as kinematics and robotics.

The University of Innsbruck also profited a lot from Manfred's services in university organization and management. Between 2004 to 2008 he was dean of the Faculty of Civil Engineering, since many years he is an influential member of the Unviersity Senate. Persistent rumors credit him with high chances to become rector but the authors know Manfred never had such ambitions.

As university teacher in Innsbruck, Manfred supervised several PhD theses. He was member of the exam committee for several other PhD defenses and two

Fig. 2. Manfred as a young professor in Innsbruck (circa 2000)

of his disciples (the authors of this article) got their habilitation as members of his research group. His collaboration with PhD candidates also tells the story of his more recent research.

Together with Friedrich Pernkopf he continued his research on Stewart-Gough platforms.[29] Central to Martin Pfurner's PhD thesis [30] is an improved inverse kinematics algorithm for general open 6R kinematic chains. Several other articles and theses are based on the often-cited article [20]. Katrin Brunnthaler's PhD thesis [2] features, among others, an algorithm for the three-pose synthesis of Bennett linkages which turned to be relevant for the recently developed factorization theory of motion polynomials [3, 28]

Together with Dominic R. Walter, Josef Schadlbauer and Thomas Stigger [31, 32, 37] he further developed his methodology, based on Study's kinematic mapping, geometric preprocessing and modern software tools for computational algebraic geometry, for synthesizing and analyzing multiply closed linkages and parallel manipulators. Several algorithms and tools developed by Manfred and his students became standard in mechanism science and are used at several other places world-wide.

3 Community Services

Paramount to the dissemination of Manfred's research results is his continuous presence as teacher in summerschools, winterschools and workshops. He gave many invited keynote lectures at conferences but also organized and co-organized numerous conferences himself. During his times in Graz and Leoben he co-organized several conferences on geometry at various locations in Styria.

Fig. 3. Manfred (circa 2013)

This conference series is still being continued today under the name of "Conference on Geometry: Theory and Applications". He organized the conference "Advances in Robot Kinematics" twice in 1998 and 2012 and initiated the EUCOMES ("European Conference on Mechanisms Science") conferences series in 2006. Other memorably events include the 16th International Conference on Geometry and Graphics in 2014 and the IFToMM D-A-CH conference in 2016.

Manfred's scientific home is IFToMM, the International Federation for the Promotion of Mechanism and Machine Science. He is chairman of IFToMM Austria since 2003 and served as chairman of the Technical Committee on Computational Kinematics from 2006 to 2008. Today he has a leading position in the renewal of IFToMM's constitution and bylaws.

Manfred's scientific achievements and community services have been recognized by the Technical University of Cluj-Napoca in Romania which awarded him with an honorary doctorate in 2013.

In addition to all these international activities Manfred never forgot his educational background in Austrian geometry. He is a long term member of ADG, the professional association of Austrian geometry teachers and edited its journal, the "Informationsblätter der Geometrie" between 2002 and 2018. This bi-annual journal is also the publication media of choice for the German Society for Geometry and Graphics DGfGG. In spite of being in German it is also read in several other countries.

Fig. 4. Manfred during a talk (circa 2018)

4 Concluding Remarks

This article is an incomplete attempt to summarize Manfred Husty's achievements as teacher and researcher in the field of kinematics, robotics and geometry. Being equipped with a strong background in classical projective, Euclidean and non-Euclidean geometry he constantly extended his scientific horizon in order to solve problems of kinematics and robotics. He introduced Lie groups to Austrian kinematics in the 1980s, made Study's kinematic mapping a respected framework for robotics research and merged with modern computational algebraic geometry to attack problems of high mathematical computational complexity.

This short biography is a feeble way of thanking Professor Manfred L. Husty for all the support and advice he gave to the authors during their career in academia. We are extremely happy of having the opportunity to collaborate with Manfred and we wish him many more years of good and happy life. As a retired professor he will be freed of much administrative work. We sincerely do hope that this will give him the chance to continue his fruitful scientific work with renewed energy.

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