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COMPUTER AIDED GEOMETRIC DESIGN

Preface

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The Special Issue at hand is dedicated to Paul de Faget de Casteljau, on whom the Faculty of Natural Sciences of the University of Berne (Switzerland) bestowed the title of "Doctor Philosophiae Honoris Causa" on December 6, 1997. The following eulogy and biography were taken from the annual report of the University of Berne for the academic year 1996–1997.

The Faculty of Natural Sciences of the University of Berne bestows the title of "Doctor Philosophiae Honoris Causa" to Paul de Faget de Casteljau from Besançon (France):

Laudatio

Paul de Faget de Casteljau

Paul de Faget de Casteljau, honoured for his fundamental scientific discoveries and inventions in the field of geometric modelling as well as his ideas with which he paved the way for computer supported construction and production.

Biography

Paul de Faget de Casteljau was born in Besançon, France on November 19, 1930. Caused by the chaos of war, his course of education led him through several Catholic schools in the region of Franche-Comté to the *Lycée Victor Hugo* where he achieved his *baccalauréat* with outstanding success. This enabled him to study at the *Ecole Normale Supérieure*. He registered for mathematics and physics.

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After his studies he did his military service in the war in Algeria. Having returned to France, he applied for a job position as a physicist at Citroën in Paris in 1958. Already during the same year he developed significant ideas within the local research group *Fraisage Numérique* of the department *Service Outillage* which would revolutionise the modelling of car bodies. Inspired by the terms polynomial, interpolation and polar forms, his supervisor named the results *courbes à pôles*. Behind this the representation of curves by means of control points can be found.

The first theoretical results were filed with the French Patent Office INPI (Institut National de la Propriété Industrielle, Paris). For quite some time, the circle of specialists never learnt anything about them. During the mid-sixties, the head of the production department at Renault, Pierre Bézier, came up with similar approaches and was able to publish them shortly after. Owing to these circumstances, the curve class found by Paul de Casteljau is called *Bézier curves* today.

Thanks to Prof. Wolfgang Boehm of the Technical University of Braunschweig, the fundamental work of Paul de Casteljau finally became known to the world of specialists in the mid-seventies. The algorithm contained in it as central idea in order to represent Bézier curves based on control points, is rightly called *algorithm of de Casteljau* since then. Nowadays, it plays a very central role in the area of modelling and representing geometric objects, and there is hardly any book on CAGD (Computer-Aided Geometric Design) without referring to it.

The field of CAGD rapidly made progress in developing new ideas. From the theory of approximation, the B-spline curves were developed in addition to this, which can be generated with an algorithm, similar to the one of de Casteljau. In 1979 de Casteljau discovered a possibility to fundamentally unite the Bézier and B-spline techniques. He named his classic control points *pôles simples* as opposed to the new *pôles progressifs*. At the beginning of the eighties he designed a quasi-interpolation method to apply these ideas, which was written down at the Académie de Besançon.

Six years later the first book of de Casteljau was published with the title *Formes à Pôles* in the sequel *Mathématique et CAO* (Conception Assisté par Ordinateur), in which he gave an account on his idea of the “pole”. Based on notes about this book Lyle Ramshaw published a research report on blossoming in 1987: A Connect-the-Dots Approach to Splines. This impulse opened a new field of research in CAGD which is still producing fruitful results.

In 1987 a second book by de Casteljau called *Quaternions* came out, in which he published results from the field of algebra, which are in particular applied in robotics. As a result he was awarded the *Prix Seymour Cray France*. In 1990, again another book was published from the field of CAGD, *Le Lissage* dealing with smoothing surfaces referring to different approaches. In 1992 Paul de Casteljau retired.

The Faculty of Natural Sciences of the University of Berne honours the research scientist Paul de Faget de Casteljau, who, outside of the university, significantly influenced and promoted an important area of applied mathematics and computer science with his ideas.

Somewhat more poignantly, Gerald Farin rates de Casteljau’s achievements as follows:

> What makes de Casteljau’s work seminal? Clearly this is the concept of Bézier curves and surfaces. In order to understand the magnitude of this contribution, one has to

consider the state of the art in CAD/CAM in the late fifties. There was some NC technology, but virtually no 3D modeling capabilities. Into this void, de Casteljau placed his new concepts, which not only solved a large majority of the problems at hand, but became the basis of all of CAGD later. (The popularity of these concepts is largely due, of course, to Bézier's slightly later developments.) All other attempts to create 3D modeling paradigms failed to have a similarly far-reaching impact: transfinite Coons and Gordon surfaces are all but extinct, methods based on Wilson–Fowler splines or Chebychev polynomials met a similar fate. The current modeling standard, NURBS, is a generalization of the original control-point-based polynomial curves; it is the concept of the control point that is central to today's modeling tools. Control points allow for unambiguous storage of data (they *represent* objects) while other procedurally defined methods do not allow this (they *approximate* objects).

The two papers following this preface give a characteristically brief account of the research of Paul de Faget de Casteljau and his environment. The first paper is an extended version of the honouring speech by Wolfgang Boehm, held on December 5, 1997. De Casteljau wrote the second paper and personally distributed it to the participants of a conference on *Free Form Curves and Free Form Surfaces*, which took place in Oberwolfach (Germany) from June 14 to 20, 1992. We hope that with the publication of these original papers we will help to show some issues in their true light.

As expected it was not difficult to obtain a sufficient number of highly qualified and relevant contributions for this special issue:

There are two papers with intriguing approximation results and sharp bounds on the distance between a curve and its Bézier polygon by Nairn et al. and Lutterkort et al. Goldman and Mazure discuss in their papers generalizations of the blossoming principle. Furthermore there are two papers, where the authors, Boehm and Degen, use the Bézier representation to obtain geometric properties of polynomial curves and surfaces. Finally, Farin and Hansford study bicubic Coons patches using their Bézier representation.

The guest editors would like to thank all the people who with their input have made this special issue possible, in particular we would like to mention Wolfgang Boehm and Josef Hoschek. We also thank Isabelle Huber for her translation into English. We especially hope to give to Paul de Faget de Casteljau a well deserved pleasure, who was also honoured as pioneer in Computer Graphics by SIGGRAPH in Orlando in 1998.

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