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Charles Care

Technology for Modelling

Electrical Analogies,
Engineering Practice, and
the Development of
Analogue Computing

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For Rachel

Preface

This book is based on research I undertook for my Ph.D. at the University of Warwick. Its motivation began when, as an undergraduate, I completed a research project on the history of planimeters and mechanical integrators. That project was my first journey into the history of analogue computing, and left me with more unanswered questions than I started with. I wanted to understand the relationship between analogue and digital computing, and what that meant for contemporary users. I found it fascinating that some historians portrayed analogue computing solely as a precursor to digital, whereas others were stressing that analogue computing existed well after 1940. Early on in my research it became clear that historians had different views of the core identity of analogue computing. In fact, it quickly became evident that even within contemporary sources, there was a spectrum of understanding around what constituted analogue computing. It was at that point I began restructuring the history around how the technology was used.

This study investigates the technologies, the concepts, and the applications of analogue computing. It is argued that analogue computing must be thought of as not just a computing technology, but also as a modelling technology. The first half of the book demonstrates how the history of analogue computing can be understood in terms of the two parallel themes of calculation and modelling, and describes how the technology evolved. The second half of the book focuses on a number of detailed case studies: examining analogue modelling in academic research, oil reservoir modelling, aeronautical design, and meteorology. Many of these case studies discuss so-called ‘direct’ analogues—analogue computers that used a direct physical analogy. Because they were not used as *calculators*, direct analogues rarely receive prominence in computing history. However, these were the analogue devices that persisted the longest.

Exploring the history in the context of modelling technology encourages us to see analogue computing in terms of its use. Rather than presenting analogue and digital as alternatives, this approach considers them complementary. The challenge is to not simply consider analogue and digital as separate technologies, but to consider the continuity of practice that spanned the two. This practice was a practice of modelling. This book is not the first account to identify a close relationship between analogue computing and modelling technology. That relationship is evident

in the sources. However, it is my aim to bring that relationship to the forefront of our historiography.

The central thesis is to demonstrate that the history of analogue computing is broader than just the technology or the machines, but must also include how it was used and applied. When we look at the history of analogue computing, we find that different people had different definitions of what analogue meant. Many histories of computing have discussed historical episodes when users debated the relative merits of analogue and digital. However, this book proposes that these ‘debates’ should be framed around application rather than technology. Because the dominant applications of analogue computing were as a modelling technology, the book argues that digital computing only became truly dominant once it too had become a practical modelling tool.

Oxford, UK

Charles Care

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Contents

Part I Modelling, Calculation and Analogy: The Themes of Analogue Computing

1	Introduction: Analogue Computers in the History of Computing . .	3
1.1	Analogue Computers: Another Class of Computing Technology . .	4
1.2	Analogue Computer: A Challenge to Define	7
1.3	Analogue Computing as Modelling Technology	10
1.4	Structure of This Book	13
1.4.1	Part I: Modelling, Calculation and Analogy: The Themes of Analogue Computing	13
1.4.2	Part II: Analogue Computing in Use: A Selection of Contexts	14
2	A Multi-Stranded Chronology of Analogue Computing	17
2.1	Two Meanings of Analogue: The Tension Between Analogy and Continuity	18
2.2	Towards a Chronology of Analogue Computing	20
2.3	First Thematic Time-Line—Mechanising the Calculus: The Story of Continuous Computing Technology	22
2.3.1	1814–1850: Towards the Mechanical Integrator: The Invention and Development of the Planimeter	22
2.3.2	1850–1876: Maxwell, Thomson and Kelvin: The Emergence of the Integrator as a Computing Component	26
2.3.3	1870–1900: The Age of the Continuous Calculating Machine	31
2.3.4	1880–1920: The Integrator Becomes an Embedded Component Initiating Associations Between Control and Calculation	33
2.3.5	1920–1946: The ‘Heyday’ of Analogue Computing?	35
2.4	Second Thematic Time-Line—From Analogy to Computation: the Development of Electrical Modelling	39
2.4.1	1845–1920: The Development of Analogy Methods	40
2.4.2	1920–1946: Pre-digital Analogue Modelling	42

2.5	Third Thematic Time-Line—Analogue Computing and the Entwining of Calculation and Modelling	47
2.5.1	1940: The Emergence of Analogue Computing as a Technical Label and Class of Machine	47
2.5.2	1945–1960: The Development and Stabilisation of Computer Technology	49
2.5.3	1950–1965: The Commercialisation of the Analogue Computer, and the Invention of Hybrid Computing	53
2.6	Conclusions	54
3	Modelling Technology and the History of Analogue Computing . . .	57
3.1	Modelling: A Variety of Definitions and Associations	58
3.2	Modelling as a Meta-Narrative for the History of Computing . . .	59
3.3	Support for Thinking of the Computer as a Modelling Medium . .	61
3.3.1	Theoretical Support for a Modelling Perspective	63
3.3.2	Historical Support for a Modelling Perspective	67
3.4	Analogue Computing as a Technology of Modelling	69
3.5	Conclusion	71
4	Origins of Analogue: Conceptual Association and Entanglement . .	73
4.1	The Establishment of ‘Forward Analogy’: Historical Influences from Electrical Theory	74
4.2	Modelling with Electricity: Early Use of a Reverse Analogy	76
4.2.1	Clifford Nickle and Vannevar Bush: Modelling with the Reverse Analogy	78
4.2.2	Establishing a Modelling Medium Based on the Reverse Analogy: The Work of Nickle and Doherty	78
4.2.3	Stabilising the Field: Bush’s Classification Schemes and Their Enrolling Function	81
4.2.4	Positive Association with Computing and Computational Rhetoric	83
4.3	Formation of an Analogue User Culture	84
4.3.1	George Philbrick and Lightning Empiricism: An Exemplar of Analogue Culture	86
4.4	Simulation Culture and the Transition to Digital	89
4.4.1	Digital Languages for Simulating Analogue Computing . .	90
4.5	Dis-enrollment of Analogue Computing and the Redefinition of Analogue Culture	91
4.6	Conclusion	93
Part II Analogue Computing in Use: A Selection of Contexts		
5	Analogue Computers in British Higher Education	97
5.1	Calculation, Modelling, or Control: Three Different Uses, Three Different Histories	101

5.2	Analogue Research at Manchester: Networks, Tanks, and Hybrid Computing	103
5.3	Analogue Research at Imperial College: Networks and Tanks as Engineering Tools	105
5.4	King's College London: Analogue Computing at 'Ultra-High Speed'	106
5.5	Analogue Computing at Birmingham	111
5.6	Analogue Computing at the University of Bath: An Example of a Technical College	115
5.7	The Flowers Report and the Funding of Analogue Computing	116
5.8	Conclusion	119
6	Analogue Computers and Oil Reservoir Modelling	123
6.1	Production Management and the Application of Analogue Computing	124
6.1.1	Modelling Hydraulic Pressures with Electricity: William A. Bruce and the Carter Analyser	125
6.1.2	Incorporating Repetitive Operation: The Reservoir Analysers Developed by the Sun Oil Company	127
6.2	The Story of the BP Analogue Computer	131
6.2.1	Outsourcing Development to EMI Electronics	133
6.3	The BP Analyser in Use	135
6.4	BP and the Analogue-Digital Debate	136
6.4.1	Analogue-Digital Issues at the Local Level	137
6.4.2	Analogue-Digital Issues at the Corporate Level	138
6.5	Conclusion	139
7	Analogue-Digital Decisions in British Aeronautical Research	141
7.1	Analogue Computing for Aeronautics	142
7.1.1	Soap Film Models as Analogue Computers	143
7.1.2	The Electrolytic Tank as a Table-Top Wind Tunnel	145
7.2	Aerodynamic Calculations, British Aircraft Designers and the ARC Computation Panel	147
7.2.1	Tanks Versus Networks	150
7.2.2	Deciding Between Analogue and Digital: The Case of Flutter	151
7.3	Thirty Year Persistence: The Shortcomings of Digitalisation	153
7.4	Conclusion	155
8	The Analogue Dishpan: Physical Modelling Versus Numerical Calculation in Meteorology	157
8.1	Computation and the History of Meteorology	158
8.2	Non-digital Approaches to Meteorology	160
8.3	Richardson's Forecast Factory and His Suggested Analogue Alternative	160
8.3.1	Richardson: Mathematician, Experimentalist, Quaker	163
8.3.2	Richardson's Rotating Fluid Experiment and the Tension Between Experiment and Mathematics	165

8.4	Dave Fultz and the Experimental Tradition of Meteorology	169
8.5	Conclusion	173
9	Conclusion	177
9.1	Three Principal Conclusions	178
9.1.1	Multiple Perspectives of Use Informing Multiple Historical Trajectories	179
9.1.2	Classifications and Social Associations in the Construction and Deconstruction of Analogue Culture	180
9.1.3	Analogue–Digital Debates Were Application Based not Technologically Based	181
9.2	Challenges for Future Scholarship in the History of Analogue Computing	182
9.3	Concluding Remarks	183
	References	185
	Index	207

List of Figures

1.1	Relevant themes to the history of analogue computing	9
1.2	An advert for the EMIAC	11
2.1	An example of an analogue and digital signal	19
2.2	The three strands of analogue chronology	21
2.3	The rolling polar planimeter and the compensating polar planimeter	24
2.4	An early drawing of the Hermann planimeter	25
2.5	The variable gear of the Hermann planimeter	26
2.6	Maxwell's planimeter designs	27
2.7	The Thomson 'Integrator'	29
2.8	The Kelvin harmonic analyser	30
2.9	The Blythswood Speed Indicator	34
2.10	Hannibal Ford's integrator patent	36
2.11	A 'program' for the differential analyser of a free-fall problem	38
2.12	Adams' electrolytic tank	42
3.1	Information <i>processing</i> and information <i>generation</i>	62
4.1	Successive stages in the evolution of electrical analogy	74
4.2	Bush's classification of 'instrumental analysis'	82
4.3	The Jerie Analogue Computer for photogrammetry	85
5.1	British analogue research theses by year, 1940–1979	99
5.2	British analogue research theses by institution, 1940–1979	100
5.3	British theses sub-divided by type of application	102
5.4	Historical trajectories of analogue calculation and modelling	103
5.5	The negative resistance circuit employed by Rushton	114
6.1	The main features of the Bruce reservoir analyser	126
6.2	The diagram of the Bruce analyser in the issued patent	128
6.3	An analyser designed by Omar Patterson of the Sun Oil Company	130
6.4	The management structure of BP's Exploration Division	132
6.5	The EMIAC II installed at Sunbury	134
7.1	Diagram of an aircraft model in the Saab electrolytic tank	147
8.1	Themes in the history of meteorology	158

8.2	A sketch of Richardson's double rotating bowl experiment	167
8.3	Dave Fultz in a laboratory setting	171
8.4	Fultz's dishpan apparatus	173

Acronyms

AC	Alternating Current (electricity)
ACA	Automatic Control Analyzer (machine)
ACE	Automatic Computing Engine (machine)
ACM	Association for Computing Machinery (professional body)
ADI	Alternating Direction Implicit (a mathematical method)
ARC	Aeronautical Research Council (British organisation)
BINAC	Binary Automatic Computer (machine)
CAT	College of Advanced Technology (type of British college)
CEGB	Central Electricity Generating Board (organisation)
CNRS	Centre National de la Recherche Scientifique (French institution)
DC	Direct Current (electricity)
DDA	Digital Differential Analyser (type of machine)
DFT	Discrete Fourier Transform (mathematical method)
DSIR	Department of Scientific and Industrial Research (British institution)
EAI	Electronic Associates Incorporated (company)
EAL	Electronic Associates Limited (company)
EDSAC	Electronic Delay Storage Automatic Calculator (machine)
EDVAC	Electronic Discrete Variable Automatic Computer (machine)
EMI	Electric and Musical Industries (company)
EMIAC	EMI Analogue Computer (machine)
ENIAC	Electronic Numerical Integrator And Computer (machine)
FAU	Friends Ambulance Unit (Quakers in World War I)
FRS	Fellow of the Royal Society of London
GAP/R	George A. Philbrick Researches (company)
GPAC	General Purpose Analog(ue) Computer (type of machine)
HCI	Human Computer Interaction
ITC	International Training Centre for aerial survey (Delft)
LIMSI	Laboratoire d'Informatique pour la Mécanique et les Sciences de l'Ingénieur
MADDIDA	Magnetic Drum Digital Differential Analyzer (machine)
MIT	Massachusetts Institute of Technology

MoS	Ministry of Supply (British government organisation)
MU	Machine Unit (analogue computing term)
NACA	National Advisory Committee for Aeronautics (US organisation)
NASA	National Aeronautics and Space Administration (US organisation)
NDRC	National Defense Research Committee (US organisation)
NPL	National Physical Laboratory (British organisation)
OED	Oxford English Dictionary
ONERA	Office National d'Etudes et de Recherches Aeronautique
ONR	Office of Naval Research (US organisation)
OR	Operational Research
RAE	Royal Aeronautical Establishment (British institution)
Rep-Op	Repetitive Operation (analogue computing term)
RSSA	Royal Scottish Society of Arts
SBAC	Society of British Aircraft Constructors
TNA	The (British) National Archives (Kew Gardens)
TRE	Telecommunications Research Establishment (British institution)
TRIDAC	Three-Dimensional Analogue Computer (machine)
UGC	University Grants Committee (British committee)
UMIST	University of Manchester Institute of Science and Technology
WPNP	Weather Prediction by Numerical Process (Richardson 1922b)