Alan Bundy, David Basin, Dieter Hutter and Andrew Ireland. ***Rippling: Meta-Level Guidance for Mathematical Reasoning.*** Cambridge Tracts in Theoretical Computer Science, vol. 56. Cambridge University Press, 2005, xiv + 202 pp.

The central problem of automated reasoning is that there are so many different potential proof paths that it is hard to know what to do next. However, in the situation where a given is being used to prove a goal, such as in the step case of an inductive proof, the technique of rippling can be used to constrain the search and guide the way to a successful proof. This technique is the subject of this book, which aims to summarize the current state of knowledge in one coherent presentation. In the opinion of this reviewer the authors have achieved this aim, resulting in a useful volume that would be ideal as an introduction for a research student or as a reference for a more seasoned academic.

The book is well written, with all the techniques explained in detail, and most importantly for a practical automated reasoning text, well motivated with clear examples. The technique of rippling has been refined, analyzed, and applied so much over the last twenty years that the organization of a book such as this is a major challenge. The authors have grouped the topics into six main chapters, which will be considered in turn.

Chapter 1: An introduction to rippling. This chapter introduces rippling, situating it within the broader contexts of automated reasoning and formal methods. To get the reader up to speed as quickly as possible, the basic rippling technique is applied to a simple example, illustrating how wave fronts expand across the formula. There is also an extremely interesting section on the history of rippling, beginning with the origin of the term in Aubin's 1976 Ph.D. thesis at the University of Edinburgh (unpublished), and continuing in chronological order with a list of the significant extensions and crediting the researchers involved.

Chapter 2: Varieties of rippling. The simple picture drawn in the introduction is refined by introducing different varieties of rippling. In addition to outwards rippling, the analogy of ripples on a pond is stretched with the introduction of inwards and sideways rippling, and the picture becomes even more complicated with higher order rippling. However, despite the difficulty of taking it all in on a first reading, there is a real benefit in having all the different techniques collected together in a single chapter, easily accessible for future reference. In addition, the techniques are introduced carefully, and each one is motivated with a simple example that cannot be dealt with by the other techniques.

Chapter 3: Productive use of failure. This chapter describes a way that rippling can be used to improve the automation of induction proofs. If rippling fails to prove the goal from the given, the failure can be analyzed by a *proof critic* to suggest a possible *proof patch*. These patches can take various forms, from setting up the initial wave fronts differently to generalizing the conjecture or suggesting helpful lemmas. Although the ideas are made clear through well chosen examples, this reviewer found the level of detail to be insufficient for a thorough understanding of the methods. However, the complexity is perhaps inherent to the task, and in common with the rest of the book the chapter contains pointers to the literature to aid further study.

Chapter 4: A formal account of rippling. Rippling is a rewriting technique, and can be analyzed using the formal language of term rewriting. In addition to confirming that rippling's rewriting with wave fronts is well behaved with respect to substitutions, the question of whether rippling terminates can be addressed by defining a suitable reduction order. Although rippling can be understood without knowing the formal basis, studying this material gives a new perspective on the technique that repays the effort.

Chapter 5: The scope and limitations of rippling. The precise scope of rippling is pinned down by looking at twelve boundary examples: the first seven of which can be proved by a technique of rippling; and the other five cannot. In addition to providing more examples of rippling in action, the failures clearly show the limits of the technique and point the way for further research in the field.

Chapter 6: From rippling to a general methodology. Many techniques in automated reasoning annotate terms to carry out their task, just as rippling does with wave fronts. This chapter presents a general language for annotating subterms, and shows how many techniques can be encoded as inference rules on formulas in this language, including rippling, basic superposition and window inference. Annotated formulas can then be mapped to abstract formulas to constrain the search for proofs—enforcing the basic restriction, rippling rules, etc. In common with all the techniques presented in the book, this framework has been implemented in an automated reasoning tool.

In addition to the six main chapters, the book has a short conclusion summarizing the different aspects of rippling covered by the book and suggesting avenues of future work, and also two appendices. Appendix 1 presents the annotated term language of Chapter 6 in more detail, and gives a sound and complete unification algorithm, while Appendix 2 defines all the functions used in the book.

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Entry for the Table of Contents: