

# Preface

Modern embedded systems in mobile and multimedia applications offer a wide range of features. They can also communicate to different devices using different standards which frequently include quite diverse sets of functional and timing requirements. For a good battery life for these devices, they have to be extremely energy efficient. All parts of such a device have to be optimized to reach an acceptable energy efficiency. This book focuses on the dynamic memory management of these devices and how to improve the energy efficiency of the data memory organization in the implementation platforms.

In order to perform a global optimization, we describe a complete, consistent framework and flow for dynamic memory exploration. Such a framework allows the designer to get a complete view enabling to see the global effects of the optimization instead of a narrow view of only local components. This book discusses the elements of the framework and the proposed flow but also the main results and guidelines we have derived from it. We also describe the different steps in the flow with an extensive set of details, such that designers can replicate the main steps and create their own custom flows for a specific target embedded platform. These steps include the effective profiling and analysis of dynamic applications, dynamic data types optimization in multimedia and communication applications, intermediate variable removal to reduce energy and footprint overhead from dynamic applications, dynamic memory management optimization to create memory managers, which effectively deal with internal and external memory fragmentation, and systematic placement of dynamic objects across heterogeneous memory hierarchies.

This book also provides an overview of the state-of-the-art literature in dynamic memory management, intended for data-dominated dynamic applications running on latest generations of portable embedded systems. The material that we present here is based on research at IMEC and its university partners in this area in the period 2001–2013.

Our approach is heavily application-driven which is illustrated by several realistic demonstrators, partly used as red-thread examples in the book. So our approach is illustrated on several representative case studies from the multimedia

and communication network application domain. Our target domain consists of embedded systems and especially dynamic systems which deal with medium to large amounts of data. This contains especially multidimensional signal processing (RMSP) algorithms like video and image processing in many different application areas including bio-oriented sensors, graphics, video coding, image recognition, medical image archival, advanced audio and speech encoding, multimedia terminals, artificial vision and graphics processing. But it also includes wired and wireless terminals which handle less regular lists of data. These are present especially in the digital communication network protocol layers.

We therefore expect this book to be of interest in academia, both for the overall description of the exploration methodology and for the detailed descriptions of the main steps. Priority has been placed on issues that in our experience are also crucial to arrive at industrially relevant results. All projects which have driven this research have also been application-driven from the start, and the book is intended to reflect this fact. The real-life applications are described, and the impact of their characteristics on the methodologies and platform components is assessed.

We therefore believe that the book will be of interest as well to senior architecture design engineers and their managers in industry, who wish either to anticipate the evolution of commercially available design concepts over the next few years, or to make use of the concepts in their own research and development.

The material in this book is partly based on work in the context of several European Commission and national research projects. In particular, this work was partially supported by the Spanish Government Research Grant TIC2002/0750 and TIN2008-00508, the EC Marie Curie Fellowship contract HPMT-CT-2000-00031, the European founded programme AMDREL IST-2001-34379 and EC FP7 FET Phidias project (Grant agreement no. 318013), the EC FP7 project 2PARMA-248716, the Swiss NSF Research Grant 20021-109450/1, and the ObeSense (no. 20NA21-143081) RTD project evaluated by the Swiss NSF and funded by Nano-Tera.ch with Swiss Confederation financing.

It has been a pleasure for us to work in this research domain and to cooperate with our project partners and colleagues in the dynamic memory management community. Much of this work has been performed in tight cooperation with many university groups, mainly across Europe. In addition to learning many new things about system synthesis/compilation and related issues, we have also developed close connections with excellent people. Moreover, the pan-European aspect of the projects has allowed us to come in closer contact with research groups with a different background and ‘research culture’, which has led to very enriching cross-fertilization. This is especially reflected in the many common publications. We want to especially acknowledge the valuable contributions and the excellent cooperation with these groups.

We would like to use this opportunity to thank the many people who have helped us in realizing these results and who have provided contributions in the direct focus of this book, both in IMEC and at other locations. That includes everyone who helped us during the Ph.D. and M.Sc. thesis research.

In particular, we wish to mention: Christos Baloukas, Luca Benini, Geert Deconinck, Vincenzo De Florio, Serge Demeyer, Jose Ignacio Hidalgo, Juan Lanchares, Rudy Lauwereins, Marc Leeman, Jose Mendias, Pol Marchal, Lazaros Papadopoulos, Georgios Pouiklis, Franco Poletti, Jose Risco-Martin, Marijn Temmerman, Antonios Thanalaikis, Liesbet Van der Perre, Karel Van Oudheusden (aka Edgar Daylight), Sven Wuytack, Chantal Ykman-Couvreur, for all their technical feedback during the research that is incorporated in this book. Indirectly, also many others have contributed in some way though and the list would be too long to explicitly mention them all here. But we do acknowledge their support.

We finally hope that the reader will find the book useful and enjoyable, and that the results presented will contribute to the continued progress of the field.

Dynamic Memory Management for Embedded Systems

Atienza Alonso, D.; Mamagkakis, S.; Poucet, C.;

Peón-Quirós, M.; Bartzas, A.; Catthoor, F.; Soudris, D.

2015, XIII, 243 p. 86 illus., 53 illus. in color., Hardcover

ISBN: 978-3-319-10571-0