PREFACE

In the last five years or so there has been an important
renaissance in the area of (mathematical) modeling, identification
and (stochastic) control. It was the purpose of the Advanced
Study Institute of which the present volume constitutes the
proceedings to review recent developments in this area with par-
ticular emphasis on identification and filtering and to do so in
such a manner that the material is accessible to a wide variety
of both embryo scientists and the various breeds of established
researchers to whom identification, filtering, etc. are important
(such as control engineers, time series analysts, econometricians,
probabilists, mathematical geologists, and various kinds of pure
and applied mathematicians; all of these were represented at the
ASI).

For these proceedings we have taken particular care to see
to it that the material presented will be understandable for a
quite diverse audience. To that end we have added a fifth tutorial
section (besides the four presented at the meeting) and have also
included an extensive introduction which explains in detail the
main problem areas and themes of these proceedings and which
outlines how the various contributions fit together to form a
coherent, integrated whole. The prerequisites needed to understand
the material in this volume are modest and most graduate students
in e.g. mathematical systems theory, applied mathematics, econo-
metrics or control engineering will qualify. And if one finds
that one does not have the prerequisites necessary to understand
the prerequisites (to quote Paul Halmos) there is no need to get
discouraged; much can be done (particularly in this field) by
means of osmosis or diffusion coupled with the ability to believe
(results of others).

The mathematical tools and results used in the area of
mathematical systems theory centering around filtering and iden-
tification have evolved considerably in the recent past. They do
not remain restricted to the obviously relevant parts of statis-
tics, probability and stochastic differential equations but also
involve techniques, concepts and results from such fields as
topology and geometry of manifolds, Lie algebras (or differential
operators), Lie groups, functional analysis (evolution semigroups),

functional integration (Feynman-Kac formulae, path integrals),
differential geometry (curvature), quantum field theory (Heisen-
berg commutation relations, Stone-v. Neumann theorem, stochastic
quantization, stochastic mechanics) and in the not too distant
future probably such topics as (harmonic) analysis on nil- and
solv-manifolds, theta functions, ...

          As indicated above there are diverse groups of scientists
to whom it is of importance to become acquainted with the various
mathematical tools available and above all to see how they work
in more or less applied situations.

          These groups do not always communicate perfectly with each
other and we hope that these proceedings will serve as a forum
for a dialogue and facilitate interspecialist appreciation and
understanding. To this end we aimed to present and discuss the
new trends in filtering and identification in an integrated
manner together with the underlying mathematics and its applica-
tions (both actual and potential) and in relation with the
mathematical problems thrown up or suggested by the various
engineering and time series approaches to filtering, identifica-
tion, adaptive control and modeling.

          We leave to the reader to judge whether these proceedings
fulfill these noble intentions.

          In any case the NATO division of scientific affairs agreed
with us that it was definitely worth trying and supplied a
substantial grant from their ASI program which put the meeting
on a sound financial basis. It is a pleasure to record here our
indebtedness to Dr T. Kester of International Transfer of Science
and Technology and Dr M. diLullo of the NATO Scientific Affairs
division for their help, advice, and encouragement also in the
earlier planning stages of this ASI.

          In addition we gave a rather large number of big industrial
corporations and other organizations the opportunity to contribute
something financial towards the success of the conference. Most
resolutely refused to help in any way (a list is available on
request) but it is pleasure to mention the favourable exceptions:
ESSO Nederland BV which supplied support which enabled us to
assist a number of participants from Non-NATO countries; NSF which
supplied the air ticket for one junior participant fron the USA
and Shell Nederland BV which donated full expenses for three
junior participants from The Netherlands. In addition North
Holland Publ. Co., Prentice Hall and especially D. Reidel Publ. Co.
and Pitman Publ. Co. helped us with a modest book display, thus
making the ASI more attractive.

          Finally it remains for us to thank the many people in our
respective institutes and the staff at Les Arcs for their manifold
efforts towards the success of the meeting.

          In addition to the tutorial and invited papers (marked
with * or ** in the table of contents) these proceedings contain
a number of contributed papers. Quite apart from the intrinsic
merits of these papers their selection mainly reflects the

idiosyncratic tastes of the editors, though we also believe that
they fit the main themes of the conference well and together
with the invited papers give a very fair picture of the emerging
new trends in modeling, identification and adaptive control and
linear and nonlinear filtering. This last topic, practically a
new emerging field, which seems to have an unusually bright
immediate future, has especially received much attention both
because of the wealth of recent fundamental results and its
glittering prospects.