MEMOIRS of the

American Mathematical Society

Number 889

Distribution Solutions of Nonlinear Systems of Conservation Laws

Michael Sever



November 2007 • Volume 190 • Number 889 (second of three numbers) • ISSN 0065-9266

2000 Mathematics Subject Classification. Primary 35L65, 35L67.

Library of Congress Cataloging-in-Publication Data

Sever, Michael, 1941-

Distribution solutions of nonlinear systems of conservation laws / Michael Sever.

p. cm. — (Memoirs of the American Mathematical Society, ISSN 0065-9266; no. 889)

"Volume 190, number 889 (second of three numbers)."

Includes bibliographical references.

ISBN 978-0-8218-3990-4 (alk. paper)

1. Conservation laws (Mathematics) 2. Nonlinear theories. I. Title.

QA377.S4642 2007 515'.3535—dc22

2007060778

Memoirs of the American Mathematical Society

This journal is devoted entirely to research in pure and applied mathematics.

Subscription information. The 2007 subscription begins with volume 185 and consists of six mailings, each containing one or more numbers. Subscription prices for 2007 are US\$649 list, US\$519 institutional member. A late charge of 10% of the subscription price will be imposed on orders received from nonmembers after January 1 of the subscription year. Subscribers outside the United States and India must pay a postage surcharge of US\$38; subscribers in India must pay a postage surcharge of US\$43. Expedited delivery to destinations in North America US\$53; elsewhere US\$130. Each number may be ordered separately; please specify number when ordering an individual number. For prices and titles of recently released numbers, see the New Publications sections of the Notices of the American Mathematical Society.

Back number information. For back issues see the AMS Catalog of Publications.

Subscriptions and orders should be addressed to the American Mathematical Society, P.O. Box 845904, Boston, MA 02284-5904, USA. All orders must be accompanied by payment. Other correspondence should be addressed to 201 Charles Street, Providence, RI 02904-2294, USA.

Copying and reprinting. Individual readers of this publication, and nonprofit libraries acting for them, are permitted to make fair use of the material, such as to copy a chapter for use in teaching or research. Permission is granted to quote brief passages from this publication in reviews, provided the customary acknowledgment of the source is given.

Republication, systematic copying, or multiple reproduction of any material in this publication is permitted only under license from the American Mathematical Society. Requests for such permission should be addressed to the Acquisitions Department, American Mathematical Society, 201 Charles Street, Providence, Rhode Island 02904-2294, USA. Requests can also be made by e-mail to reprint-permission@ams.org.

Memoirs of the American Mathematical Society is published bimonthly (each volume consisting usually of more than one number) by the American Mathematical Society at 201 Charles Street, Providence, RI 02904-2294, USA. Periodicals postage paid at Providence, RI. Postmaster: Send address changes to Memoirs, American Mathematical Society, 201 Charles Street, Providence, RI 02904-2294, USA.

© 2007 by the American Mathematical Society. All rights reserved.

Copyright of individual articles may revert to the public domain 28 years after publication. Contact the AMS for copyright status of individual articles.

This publication is indexed in Science Citation Index®, SciSearch®, Research Alert®, CompuMath Citation Index®, Current Contents®/Physical, Chemical & Earth Sciences.

Printed in the United States of America.

The paper used in this book is acid-free and falls within the guidelines established to ensure permanence and durability. Visit the AMS home page at http://www.ams.org/

10 9 8 7 6 5 4 3 2 1 12 11 10 09 08 07

Contents

Chap	oter 1. General distribution solutions	1
1.	Something worse can happen	1
2.	Background	6
3.	Form of distribution solutions	9
4.	Delta-shocks and singular shocks	19
5.	Entropy inequalities	24
6.	Symmetries	27
7.	Symmetry groups and phase space coordinates	33
Chapter 2. Delta-shocks		44
1.	The structural conditions	44
2.	Definition of solutions	50
3.	Delta-shocks and Lagrangian coordinates	54
4.	Continuation of delta-shock solutions	59
5.	Nonhyperbolic systems with delta-shock solutions	67
6.	Strictly hyperbolic, linearly degenerate pairs	70
7.	Additional examples	75
Chapter 3. Singular shocks		81
1.		81
2.	Examples of systems admitting singular shocks	95
3.	Viscous structure of singular shocks	100
4.		109
5.	Whence they came, where they went	122
6.	그는 살이 이번에 되었다. 그 그래요 그는 사람이 아이를 가면 하지만 하지만 하지만 하지만 하다.	141
Dibliography		160