S a i na Ex an i n Sh ck f a Regula i ed B u ine S em

By Gennady A. El, Mark A. Hoefer, and Michael Shearer

1. Introduction

(3) 1 $u_\pm$ $h_\pm$
1 *RH locus*

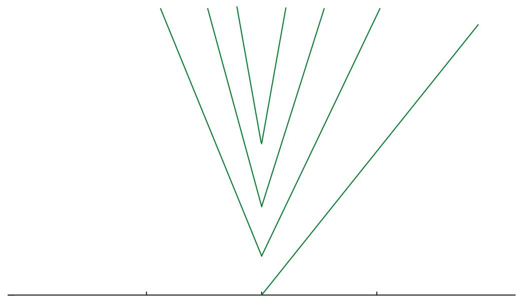
$$u_\pm \quad h_\mp \left(\frac{2}{h \quad h}\right)^{1<2} \tag{4}$$

(2) (3) 1
1 1 (1),

2. Expansion shock Riemann data

h_t (

3. BBM approximation and the structure of the expansion shock



1, , δ-

1.

4. Expansion shock for the Boussinesq equations

1 1 1 1

(17) 5, 1 1.

5 1

D $x<\delta$,

T δt, B (17)

1 $x.t$

1 1

1.

1, ,

1

1 : , 1 $\sim H$ 1

((13)) 1 1 δ,

, 1

11 H 1.

4.1. Inner solution: first -order approximation

A 1 δ

, (17)

$x<\delta$, t, 1 0 $\ll 1$

1 1 ,

, (17)

$$r^{( )} \quad \frac{1}{4\delta}(3r^{( )} \quad s^{( )})r^{( )} \quad \frac{}{6\delta^2}\left(r^{( )} \quad s^{( )}\right)$$

$$s^{( )}$$

$r^{(0)}, r^{(1)}, r^{(2)}, s^{(0)},$ $s^{(2)}$ (1) $\to 0,\ \delta \to 0,\ \to 0.$

1 1 1 1 r (15),

1 s $s^{(1)}$ 0,

1 ,

.

1 (21) (20),

$$\left(r^{(1)} \quad \cdots\right)$$

$$\frac{1}{4\delta}\left(3r^{(0)} \quad s^{(0)} \quad 3r^{(1)} \quad {}^2(3r^{(2)} \quad s^{(2)}) \quad \cdots\right)\left(r^{(1)} \quad {}^2 r^{(2)} \quad \cdots\right)$$

$$\overline{6\delta^2}\left(r^{(1)} \quad {}^2\left(r^{(2)} \quad s^{(2)}\right) \quad \cdots\right) \tag{22}$$

$$\left({}^2 s^{(2)} \quad \cdots\right) \quad \frac{1}{4\delta}\left(r^{(0)} \quad 3s^{(0)} \quad \cdots\right)\left({}^2 s^{(2)} \quad \cdots\right)$$

$$\overline{6\delta^2}\left(r^{(1)} \quad \cdots\right). \tag{23}$$

B $\ll 1/\delta$, (22)

$$\left(\frac{}{\delta}\right): \quad \frac{1}{}$$

$$\frac{2a}{9a^2} \qquad \frac{ff'}{f''} \qquad K. \tag{30}$$

$K \,/\, 0$ 1 . a f BB
5

$$a(\;) \quad \frac{A}{\frac{9}{2}AK \quad 1}. \qquad f(\;) \quad B \left(\frac{B}{2K}\right. \quad . \tag{31}$$

$A \,/\, 0$ $B \,/\, 0$ 1
1

$$B \quad 1. \quad K \quad \frac{1}{2}. \tag{32}$$

1 , 1 A,
, (31)

$$a(\;) \quad \frac{A}{\frac{9}{4}A \quad 1}. \qquad f(\;) \quad (\;) \tag{33}$$

, 1 1

$$r^{(\;)}(\;.\;) \quad \frac{s^{(0)}}{3} \quad \frac{A}{\frac{9}{4}A \quad 1} \;(\;) \quad (^2). \tag{34}$$

$$s^{(\;)}(\;.\;) \quad s^{(0)} \quad (^2) \tag{35}$$

1 $s^{(0)}$ A
, (34), (35) 0, $\to$, 1
, 1 1 (12)
1 :

$$r_{\pm} \quad \frac{s^{(0)}}{3} \pm A \quad (^2). \tag{36}$$

$s_{\pm}$

$> _t \gg _x$ 0, > $\frac{1}{4}(s^{(0)}$ 3r) (, (19)).
1 BB (18). ,
>
BB 1 5 .

E . 11 1

$$r^{( )}(.) \sim 1 \quad \left(\frac{1}{4} \quad \frac{( )}{1 \quad \frac{9}{4}} \right)$$

$$\frac{\ ^2}{3} \left(C \quad \frac{2 \quad 17 \quad ^2( ) \quad D \ ( ) \quad E \quad ( )}{16 \left(1 \quad \frac{9}{4} \ \right)^2} \right).$$

$$s^{( )}(.) \sim 3 \quad \frac{3}{4} \quad ^2 \left(C \quad \frac{3 \quad ^2( )}{16 \left(1 \quad ^9\right.} \right.$$

$$r^{(\ )} \quad \frac{1}{4}(3r^{(\ )} \quad s^{(\ )})r_X^{(\ )} \quad 0.$$

$$s^{(\ )} \quad \frac{1}{4}(r^{(\ )} \quad 3s^{(\ )})s_X^{(\ )} \quad 0 \tag{51}$$

1 1 , 1

$$s^{(\ )}(X.\ ) \quad 3 \quad \frac{3}{4} \quad \frac{1}{32}{}^{2} \quad \cdots.$$

$$r^{(\ )}(X.\ ) \quad 1 \quad \left(\frac{1}{4} \quad r_1(X.\ ) \quad {}^{2}\left(\frac{1}{96} \quad r_2(X.\ ) \quad \cdots \right.\right. \tag{52}$$

1 , (5) $s^{(\ )}$ r . $r^{(\ )}$, 1 1

(58). (50),

$$\lim_{X\to 0^{\pm}} r_2(X. \quad) \quad F_2^{\pm}\frac{1}{\left(1 \quad \frac{9}{4} \quad\right)^2} \qquad \to\pm \quad r^{(2)}(\; . \;) \quad \frac{1}{24\left(1 \quad \frac{9}{4} \quad\right)^2}. \tag{60}$$

F_2 F_2 1<24,

$$r_2(X. \quad) \quad \frac{1 \quad 3 \; X}{24\left(1 \quad \frac{9}{4} \quad\right)^2} \tag{61}$$

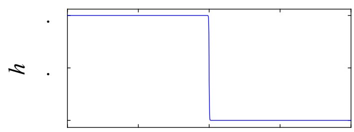
11

$$r^{(\;)}(X. \quad) \quad 1 \quad \left(\; \frac{1}{4} \quad \frac{X \quad 3X}{1 \quad \frac{9}{4}} \right)$$

$$\frac{\quad^2}{24}\left(\; \frac{1}{4} \quad 1 \quad 3\right.$$

, , 1 1 , 1

$r^{(\ )}(X. \ ) \quad 1$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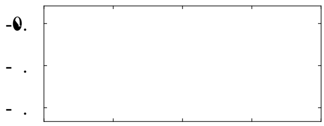
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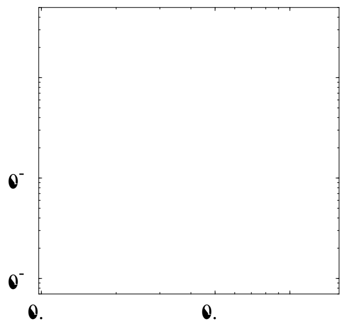

6. Discussion

[illegible]

Acknowledgments

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Appendix

A 1 1 1 11 . L. L x_n L $2Ln/N$, n 0, . . . , N 1. 1 h u, 1 g h_x, u_x

$$g_t \quad (ug)_x \quad (h\,)_x \quad 0.$$

$$_t \quad (u\,)_x \quad g_x \quad \frac{1}{3}\,_{xxt} \quad 0 \tag{A1}$$

B L $h(\pm L, t)$ $h_\pm$ $u(\pm L, t)$ $u_\pm$ 10^{9} g 1 (A1) 1 1 1 1 1 1 ,

$$(ug)_{x\ n} \quad ik_n\, ug\ _n, \quad n \quad N/2, \ldots, N/2 \quad 1. \tag{A2}$$

1 1 k_n n/L h 11 g

$$h(x_n, t) \quad h \quad ^{1}\, g(t)\ _n \quad \frac{1}{2L}(h \quad h\ )(x_n \quad L). \tag{A3}$$

$$g_n(t) \quad \begin{cases} \dfrac{2L}{N}\displaystyle\sum_{m \quad N/2}^{N/2 \quad 1} x_m g(x_m, t) & n \quad 0 \\ \dfrac{g_n(t)}{ik_n} & n \quad 0 \end{cases} \tag{A4}$$

n 0 (A4) 1 11 $\int_{L}^{L} xg(x, t)dx$ h g . A 1 1 u.

1 1 , 1 > xxt < 3 (A1) 1 0.002 t 45. L 120 (. 2 3 1) N 2^{14}. 1,