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Novel wide-angle AVO attributes using rational function

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Abstract

C AVO - , ( ) (40°). H , (-), - , . H , - AVO. - - , - - AVO. AVO . O - AVO .

Keywords S _ L _ - AVO R

Introduction

I , AVO (A V O -) . T AVO - AVO - . B , - , NMO - (K B 1983; 1985). H , , - . AVO - . (D T 1995; D U , 2006).

H , AVO , AVO (B - 1961; A R 1980; S 1985). B , , (O B 1963; M . 1987). T , - AVO .

T - , , - . T , , . T , - (M 2015).

I , , (H 1961; H 2004; A . 2009; U . 1949). A , -

V @ .

J 12@163.

I J V V @ .

[1] C I S E , C U P (B), B 102249, C

[2] S K L P R P , C U P (B), B 102249, C

S , - - . I , - - , D - . I , AVO - . T ., . I , ; , AVO, , . T , .

Theory

AVO , PVO ; θ( ):

$$H(\theta) = |H(\theta)|e^{i\phi(\theta)} \tag{1}$$

$|H(\theta)|$ AVO $\phi(\theta)$ PVO; - . F (1) :

$$(s) = \sum_{k=1}^{n} \frac{C_k}{s - A_k} + D \tag{2}$$

$s = j2\pi r$, A_k , C_k - , r , D .

B , - - (L . 2016):

$$R_{pp}^{sph} = \frac{\int_1^0 B(x)J_0(\omega r\sqrt{1-x^2}/v_1)e^{i\omega x(h+z)/v_1}\mathrm{d}x + i\int_0^\infty B(x)J_0(\omega r\sqrt{1+x^2}/v_1)e^{-\omega x(h+z)/v_1}\mathrm{d}x}{\int_1^0 J_0(\omega r\sqrt{1-x^2}/v_1)e^{i\omega x(h+z)/v_1}\mathrm{d}x + i\int_0^\infty J_0(\omega r\sqrt{1+x^2}/v_1)e^{-\omega x(h+z)/v_1}\mathrm{d}x} \tag{3}$$

B PP- :

$$B(x) = \frac{\rho_2 v_2 x - \rho_1 v_1\sqrt{1 - v_2^2/v_1^2(1-x^2)}}{\rho_2 v_2 x + \rho_1 v_1\sqrt{1 - v_2^2/v_1^2(1-x^2)}} \tag{4}$$

v_1, v_2, ρ_1, ρ_2 P- , , J_0 - B , r $(r = (h+z) * tan\theta)$, h z , , i $x = cos\theta, \omega$. T (3) - - , (2) - ; , - . I (2), A_k - , , V F (G S 1999) , , - . S A_k (2), $H(s)$ $\sigma(s)$, $\sigma(s)$; :

$$\begin{pmatrix} \sigma(s)H(s) \\ \sigma(s) \end{pmatrix} = \begin{pmatrix} \sum_{k=1}^{n} \frac{C_k}{s-\widetilde{A}_k} + D \\ \sum_{k=1}^{n} \frac{\widetilde{C}_k}{s-\widetilde{A}_k} + 1 \end{pmatrix} \tag{5}$$

N (5) $\sigma(s)$ $\sigma(s)\,H(s)$. M (5) $H(s)$ - :

$$\sum_{k=1}^{n} \frac{C_k}{s-\widetilde{A}_k} + D = \left[\sum_{k=1}^{n} \frac{\widetilde{C}_k}{s-\widetilde{A}_k} + 1\right] H(s) \tag{6}$$

O

$$(\sigma H)_{\mathrm{fit}}(s) = \sigma_{\mathrm{fit}}(s)H(s) \tag{7}$$

E (6) $C_k, \widetilde{C}_k$. S , :

$$\mathsf{A}\widetilde{\mathsf{x}} = \mathsf{b} \tag{8}$$

$\widetilde{x}$. E
(8) -
θ_k s_k :

$$A_k\widetilde{x} = b_k \tag{9}$$

$$A_k = \left[\frac{1}{s_k-\widetilde{A}_1} \cdots \frac{1}{s_k-\widetilde{A}_N} \; 1 \; \frac{-H(s_k)}{s_k-\widetilde{A}_1} \cdots \frac{-H(s_k)}{s_k-\widetilde{A}_N} \right] \tag{10}$$

$$\widetilde{x} = \left[c_1 \cdots c_N \; D \; \widetilde{c}_1 \cdots \widetilde{c}_N \right] \tag{11}$$

$$b_k = H(s_k) \tag{12}$$

T , $H(s)$
(6) .
I (6) -
, :

$$(\sigma H)_{\text{fit}}(s) = h\frac{\prod_{k=1}^{n+1}(s-z_k)}{\prod_{k=1}^{n}(s-\widetilde{A}_k)}, \sigma_{\text{fit}}(s) = \frac{\prod_{k=1}^{n}(s-\widetilde{z}_k)}{\prod_{k=1}^{n}(s-\widetilde{A}_k)} \tag{13}$$

$z_k, (k = 1, 2, 3 \ldots n)$ $(\sigma H)_{\text{fit}}(s)$, $\widetilde{A}_k$
$\sigma_{\text{fit}}(s)$ $(\sigma H)_{\text{fit}}(s)$, $\widetilde{z}_k$ $\sigma_{\text{fit}}(s)$.
F :

$$H(s) = \frac{(\sigma H)_{\text{fit}}(s)}{\sigma_{\text{fit}}(s)} = h\frac{\prod_{k=1}^{n+1}(s-z_k)}{\prod_{k=1}^{n}(s-\widetilde{z}_k)} \tag{14}$$

E (14) $H(s)$
$\sigma_{\text{fit}}(s)$. T , $\sigma_{\text{fit}}(s)$
$H(s)$. A $H(s)$
E . (14).
V F
. B ,
.

Results

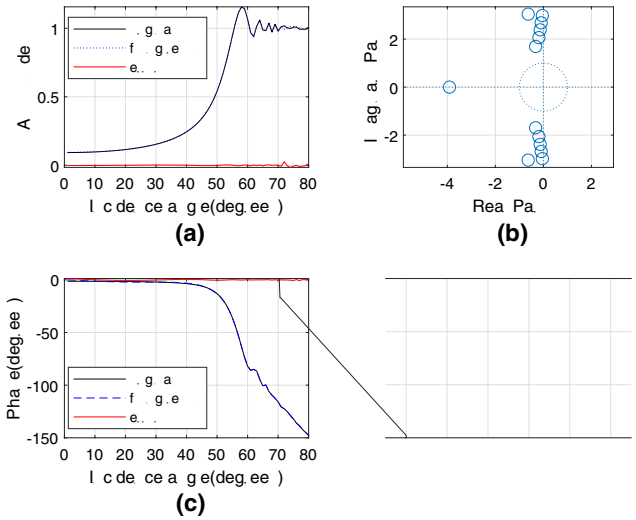
Fitting

I , -
C . (1998) L . (2016) ,
T 1, v_1, v_2, ρ_1, ρ_2 .

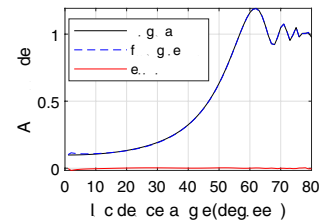
Table 1 P AVO (-)

M	$v_1/(\text{m s}^{-1})$	$\rho_1/(\text{g cm}^{-3})$	$v_2/(\text{m s}^{-1})$	$\rho_2/(\text{g cm}^{-3})$
A (1 /)	3093	2.40	4050	2.21
B (1 /)	3093	2.40	4114	2.32
C (2 /)	2642	2.29	2781	2.08
D (2 /)	2642	2.29	3048	2.23
E	2000	2.40	2933	2.20

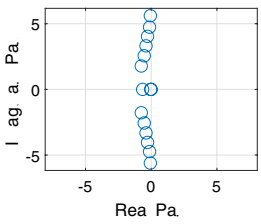
F ,
AVO .
B - -
, ,
-
.
T ; , -
, ,
.
– 40 B, -
. T R
10 H ,
10 H .
T - AVO /, -
A D
F . 1 - ( ) ( ) ,
. I -
AVO . T
- ( )
( ). F ,
, ,
. A , ,
.
A
AVO, ,
AVO. I F . 2 M E ( ), 12
– 40 B. N 6
,
F . 2 M E ( );
6 -
, .
S



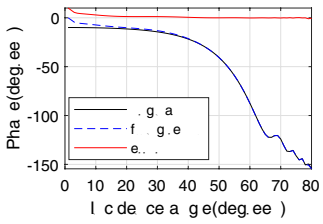
, -
- AVO. ;
I .
- - A F . 4, -
(S 1985) , . T , ;
F . 3 4 E. - AVO ,
F 3 - AVO -
, , - . M A B ,
.
,



(a)



(b)



(c)

Applying

. F - AVO, A C, B , , / , A AVO AVO 1, C 2; B . F A D, D, / ,

Fig. 4 M E: **a** I - ρ_1. **b** A - ρ_1. **c** I -

B AVO 1, D 2. F , A B, AVO 1, A / , B / ; C D AVO 2, C / , D / .

F , A D, . T F . 5 . T , - - . A , , - 40°. A , , - . T A C F . 6. F , F . 6 - F . 6 . I , A, C. I , , AVO - - , AVO - . A B D F . 7, F . 6 . I AVO, - . F 8 A B,

Fig. 6 C AVO
(A: ,
C:). **a** I -
- ( ).
b L
( )

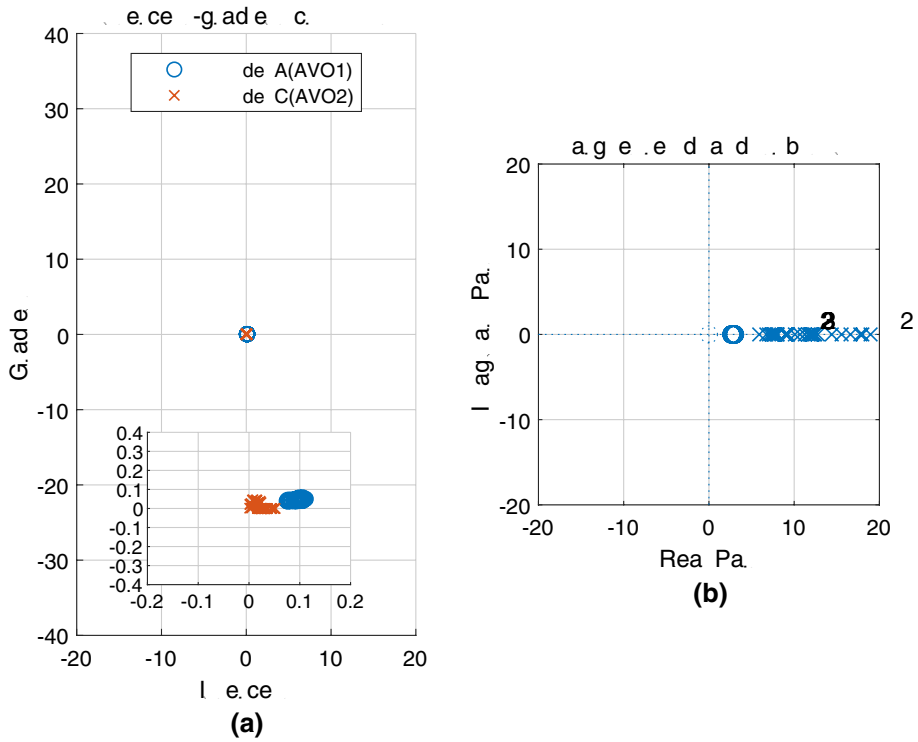
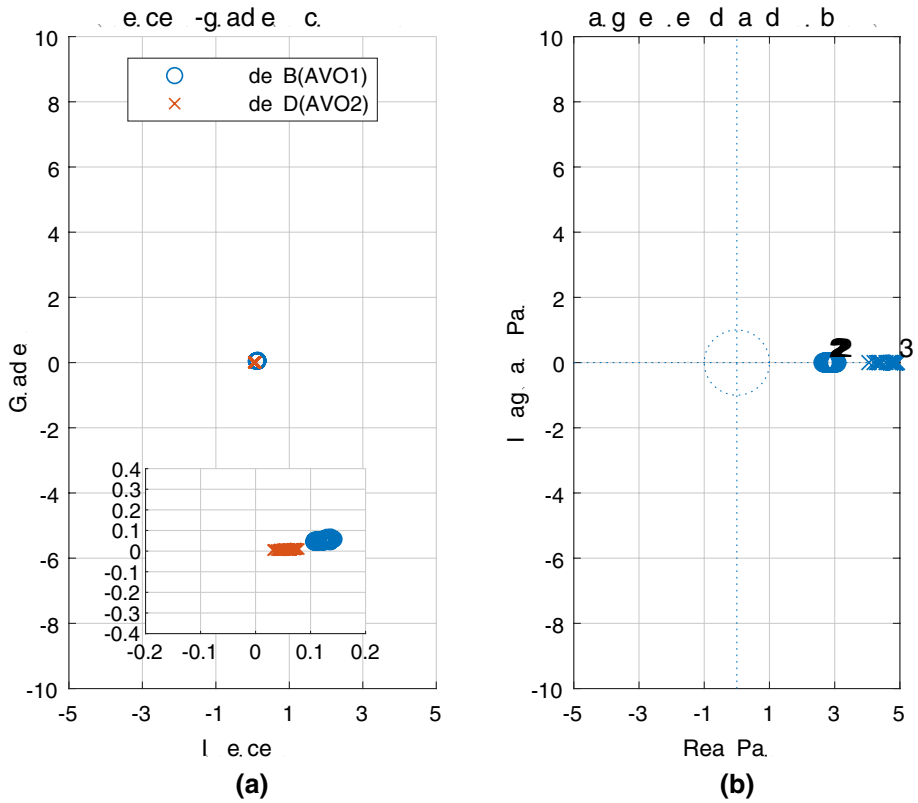


Fig. 7 C AVO
(B: ,
D:). **a** I -
- ( ).
b L
( )



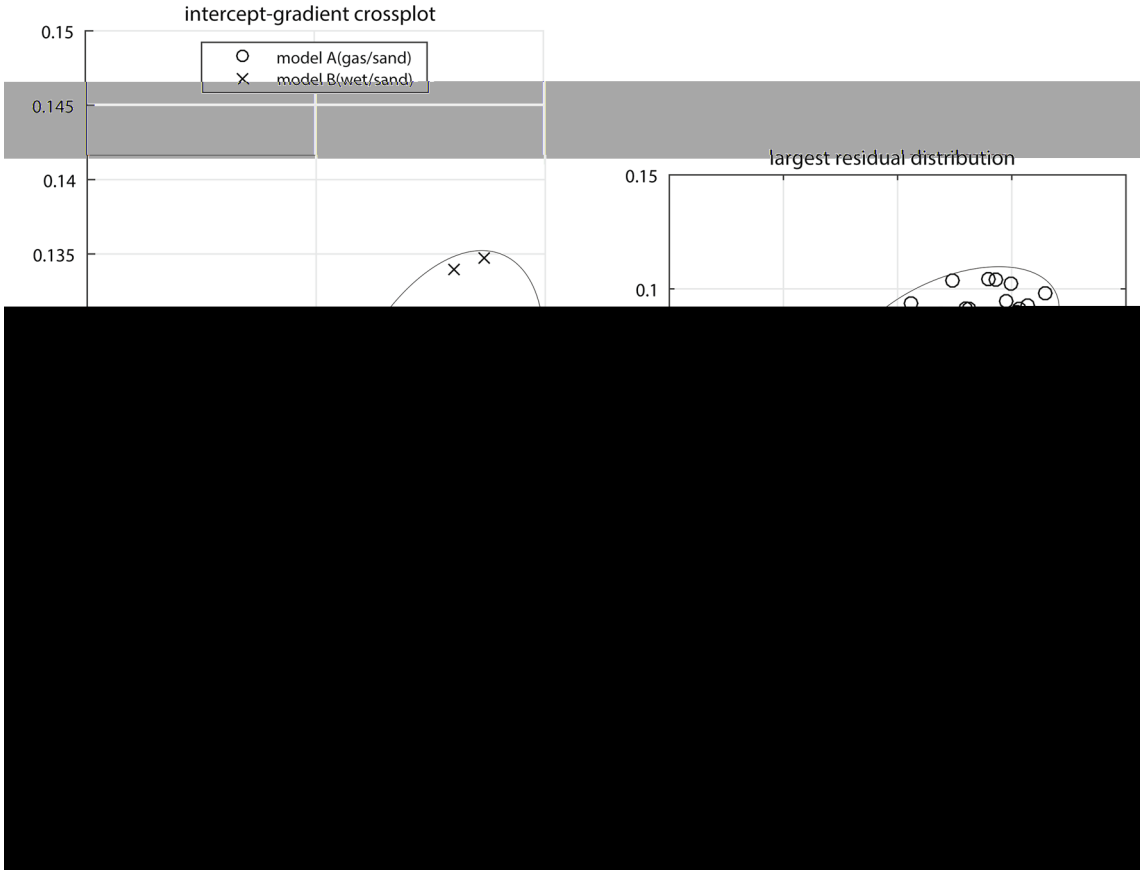


Fig. 8 C AVO (A: , B:). **a** I - - - ( ). **b** L ( )

F . 9 C D. A AVO , A B 0.0483 C D 0.0557; - , - , - A B 0.1006 > 0.0483, C D 36.0907 > 0.0557. T - , , - .

Conclusion

T : AVO . I ,

- AVO, , V F . B AVO , - AVO - AVO . B , - , . T - - , AVO . T - - . A , - AVO , - . S , AVO - . I , - , .

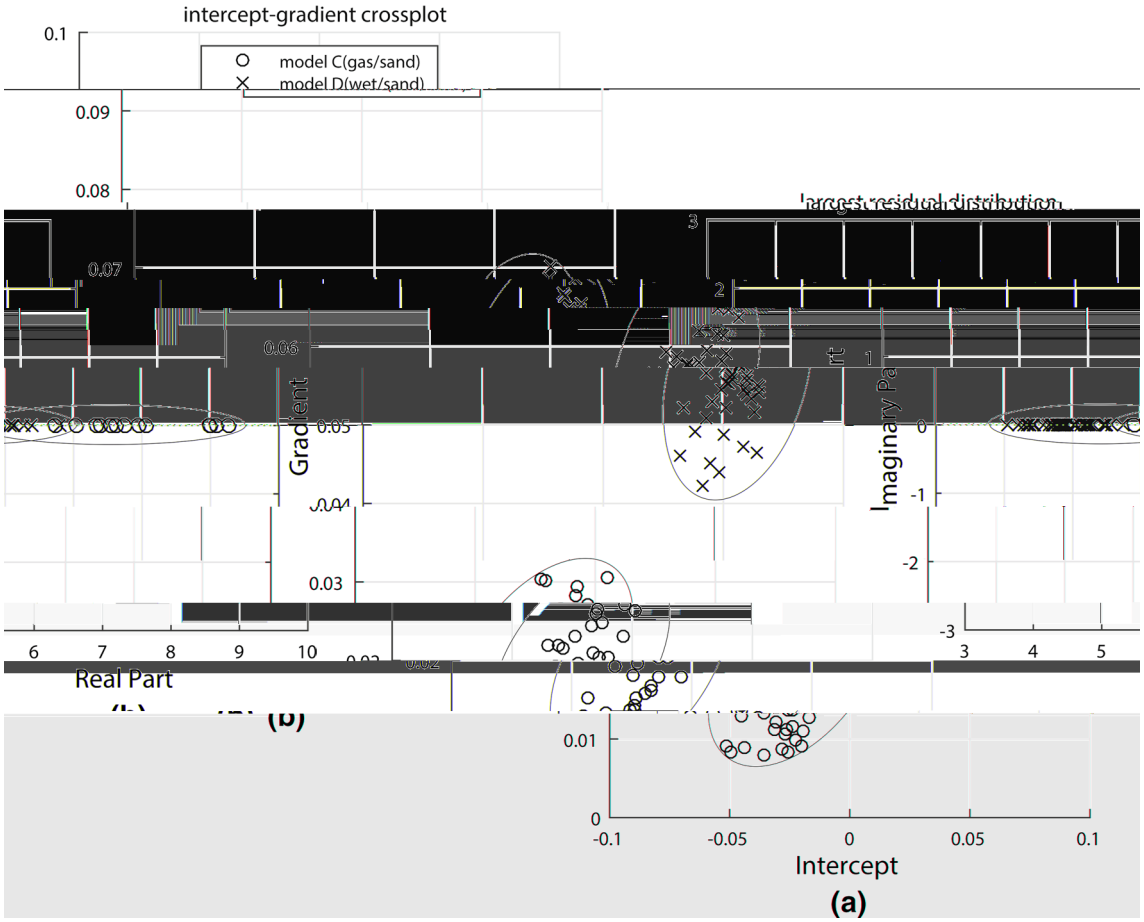


Fig. 9 C AVO (C: , D:). **a** I - - - ( ). **b** L ( )

Acknowledgements T C U P (B). AVO/AVA V F , J L - G H .

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