Covering letter

Authors' Response

Dear Editor and Reviewers,

Thank you for your valuable time in reviewing our manuscript (Manuscript ID: electronics-4032066, titled "An Zero-Point Drift Suppression Method for eLoran Signal Based on Inaction Algorithm"). We are grateful for your detailed comments, which have helped us improve the quality of the paper. The reviewers' concerns are addressed in the order in which they are mentioned. The comments are pasted below in *red* and *italics*, and our responses follow closely.

Thank you again for reading our work and responses.

Sincerely,

The Authors

Response to reviewer 3's comments:

1、summary

Thank you for your thorough review and careful consideration of this issue. We have addressed your concerns as follows:

2、Reviewer's Evaluation

Questions for General Evaluation	Reviewer's Evaluation	Response and Revisions
Does the introduction provide sufficient background and include all relevant references?	Yes	I will give my corresponding responses in the point-by-point response letter.
Is the research design appropriate?	Can be improved	
Are the methods adequately described?	Yes	
Are the results clearly presented?	Can be improved	
Are the conclusions supported by the results?	Can be improved	
Are all figures and tables clear and well-presented?	Yes	

3、Point-by-point response to Comments and Suggestions for Authors

Comments 1: *[how to define zero-point drift percentage?]*
Response 1: *Thank you for pointing this out. We agree with this comment.*
[Zero-point drift refers to the deviation observed in the time series between the positive zero-crossing point of the third period of the reconstructed signal and that of the original signal.]
Revised manuscript:

pensates for zero-point drift (the deviation observed in the time series between the positive zero-crossing point of the third period of the reconstructed signal and that of the original signal) by 79.3% and maintains third-week forward over-zero error at a very low level. 24 25 26

Comments 2: *[what is antenna bottom current?]*

Response 2: *Thank you for pointing this out. We agree with this comment.*

[The bottom current of the antenna denotes the peak current that flows from the output terminal of the transmitter into the ground network at the base of the antenna tower within the eLoran transmission system. This current directly influences the field strength and coverage area of the radiated signal. In the time domain, the current at the base of the antenna appears as a 100 kHz radio frequency pulse current, modulated in accordance with the shape of the eLoran envelope.]

Revised manuscript:

tenna. In the time domain, the current at the base of the antenna appears as a 100 kHz radio frequency pulse current, modulated in accordance with the shape of the eLoran envelope, the following expression for the bottom current of the antenna $i(t)$:

Comments 3: *[why 65? and why tao<t<tao-65?]*

Response 3: *Thank you for your thoughtful review and careful assessment of our manuscript. We have revised this to emphasize this point.*

[The eLoran signal attains its maximum rising speed at 65 μs , thus the time (t) for the eLoran pulse phase ranging difference system is established at 65 as the threshold. A detailed derivation is available in the literature: Wu, M., Zhu, Y., Li, F., Xu, J. Radio Navigation Principle and Signal Receiving Technology; National Defense Industry Press: Beijing, China, 2015; ISBN 978-7-18-09795-5. (Reference 4)]

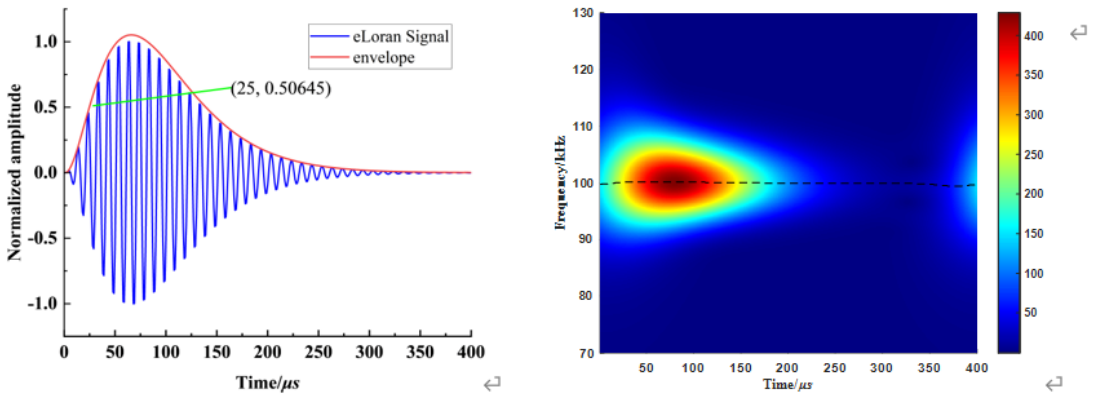
Comments 4: *[what is the imaginary line?]*

Response 4: *Thank you for pointing this out. We agree with this comment.*

[The imaginary line is the envelope of the eLoran signal.]

Revised manuscript:

where "i(t)" is the antenna current of the eLoran waveform; "A" is the normalization constant (unit A) related to the antenna current peak; "t" is the time (unit μs); "τ" is the envelope to cycle difference (ECD) (unit μs); "pc" is the phase encoding parameter (unit rad).



(a) (b)

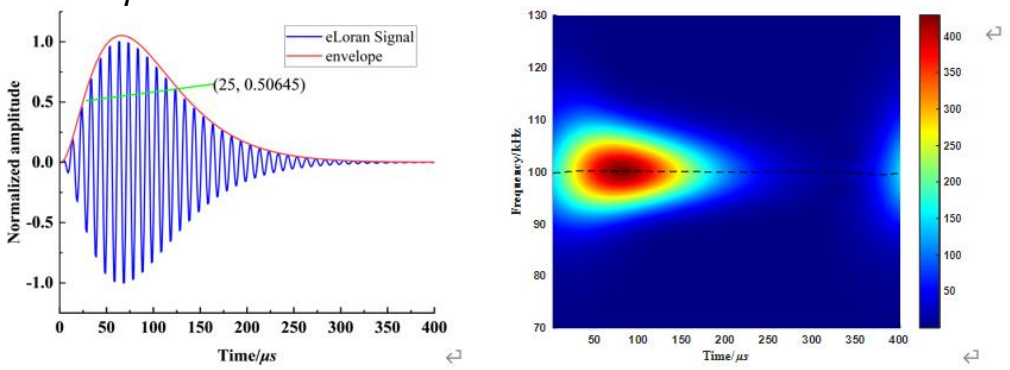
Figure 1. The eLoran normalized waveform and NTFT spectrum:(a) eLoran single pulse shape and pulse-shaped envelope; (b) eLoran single pulse NTFT spectrum.

ECD denotes the temporal shift of the pulse-shaped envelope, defined as the imaginary line connecting the peak of each sinusoidal period, resulting from signal propagation

Comments 5: *[how do you get this NTFT plot?]*
Response 5: *Thank you for your thoughtful review and careful assessment of our manuscript. We have revised this to emphasize this point.*
[The NTFT spectrum is obtained through standard time-frequency transformation. The correlation coefficient, as defined in Equation 19, is then extracted and represented in a pcolor diagram. In this diagram, the horizontal axis denotes time (in μs), the vertical axis represents frequency (in kHz), and the color intensity indicates the energy level corresponding to each time-frequency position, and the dashed line represents the maximum value of the eLoran signal spectrum over time.]

Comments 6: *[how to get this plot from (1)? or what relation between them?]*
Response 6: *Thank you for raising this out. We agree with this comment.*
[Figure 1 (a) illustrates the time-domain representation of the eLoran signal, which was directly simulated and generated in MATLAB using Equation 1. Figure 1 (b) denotes the frequency-domain characteristics of the eLoran signal. The vertical axis denotes that the frequency range of the eLoran signal is concentrated between 90 kHz and 110 kHz, while the color depth indicates the energy magnitude at the corresponding time and frequency.]

Comments 7: *how this is shown in figure (1)a?]*
Response 7: *Thank you for your thoughtful review and careful assessment of our manuscript. We have revised this to emphasize this point.*
[It has been carefully revised in the original manuscript.]
Revised manuscript:



(a) (b)

Comments 8: *[please add more detail words on how to read the Figure 2, linked with above equations.]*
Response 8: *Thank you for pointing this out. We agree with this comment.*
[The input signal is first constructed using MATLAB. Subsequently, the frequency domain range of 90-110 kHz is established based on the NTFT spectrum diagram (Equation 19). This main frequency band of 20 kHz is finely divided into 200 sub-frequency bands. The energy proportion of each sub-frequency band within the main frequency band is then calculated. The signal for each sub-frequency band is re-constructed using a non-action algorithm (Equations 25-36). Finally, weighted fusion is performed according to the energy proportions of the sub-frequency bands, resulting in the superimposition and reconstruction of the original signal.]
Revised manuscript:

The input signal is first constructed using MATLAB. Subsequently, the frequency domain range of 90-110 kHz is established based on the NTFT spectrum diagram (Equation 19). This main frequency band of 20 kHz is finely divided into 200 sub-frequency bands. The energy proportion of each sub-frequency band within the main frequency band is then calculated. The signal for each sub-frequency band is reconstructed using a non-action algorithm (Equations 25-36). Finally, weighted fusion is performed according to the energy proportions of the sub-frequency bands, resulting in the superimposition and reconstruction of the original signal. The initial frequency domain filtering process of

Comments 9: *[what of these frequency bandwidths? Multi-narrowband frequency?]*
Response 9: *Thank you for pointing this out. We agree with this comment.*
[The frequency bandwidth of eLoran is defined as 20 kHz (90-110 kHz). Multi-band narrowband interference involves the superposition of narrowband interference from multiple distinct frequencies, where these frequencies correspond to the values of the added narrowband interference. Narrowband interference (NBI) is a prevalent form of interference encountered in eLoran receivers, primarily characterized by sinusoidal interference signals that possess significantly greater energy than the eLoran signal.]
Revised manuscript:

zero-point drift and enhancing reconstruction accuracy under low SNR conditions, a standard eLoran group signal was generated using MATLAB. This signal was subjected to multi-frequency narrowband interference which refers to the superposition of narrowband interference of multiple different frequencies, and band-limited random noise, both

Comments 10: *[what means noise frequency? why pick these frequencies?]*
Response 10: *Thank you for your thoughtful review and careful assessment of our manuscript. We have revised this to emphasize this point.*
[Narrow Band Interference (NBI) is a prevalent form of interference encountered in eLoran receivers. It primarily consists of sinusoidal interference signals that possess significantly greater energy than the eLoran signal, thereby severely affecting the positioning accuracy of these receivers. Based on the frequency relationships between narrowband signals and eLoran systems, NBI can be categorized into synchronous interference, near-synchronous interference, and asynchronous interference. Synchronous interference occurs when the spectral line of the interference signal aligns with the Roland C spectral line, indicating that the frequency of the interference signal is an integer multiple of the minimum group repetition interval of the eLoran signal. Near-synchronous interference is characterized by interference signals whose frequency spectral lines are relatively close to the eLoran spectral lines, falling within the tracking bandwidth of the receiver. Its effects are akin to those of synchronous interference. In contrast, asynchronous interference arises when the frequency spectral lines of narrowband interference are distanced from the eLoran spectral lines, with the frequency difference exceeding the tracking bandwidth.]
Revised manuscript:

at an SNR of -30 dB, with narrowband interference frequencies of 87.5 kHz, 92.5 kHz, 97.5 kHz, and 105.5 kHz, which includes synchronous interference, near-synchronous interference and asynchronous interference.↵

Comments 11: *[any reasons of pick these waveforms? can you discuss how this setting is close to real scenarios?]*

Response 11: *Thank you for pointing this out. We agree with this comment.*

[Band-limited random noise and narrowband interference are prevalent types of interference encountered in eLoran receivers, consistent with natural scenarios. The source of this interference can be traced to the General Technical Conditions for Marine Loran-C Receiving Equipment (Reference 31).]

Revised manuscript:

ulating near-synchronous and synchronous interference for experimental purposes. The 405
$f_1(t)$ is defined by the following formula [31]: 406

Comments 12: *[All of your wave plots are shown as normalized outputs. Can you clarify what they are normalized to? I suggest instead defining a similarity function between the filtered signal and the standard signal, specifically in the region in the block. Since the main concern is the correctness of the zero-crossings, the similarity measure should emphasize that aspect. Whether other parts of the waveform match or not is less important.]*

Response 12: *Thank you for pointing this out. We agree with this comment.*

[Normalization is essential for assessing the matching degree of the waveform. This is due to the fact that, in addition to ensuring the accuracy of the zero-crossing point in the third period, the waveform's matching degree also indirectly influences the positioning accuracy of the eLoran receiver. The identification of the zero-crossing point in the third period typically relies on the waveform characteristics of the Roland C signal for discrimination. Distortion of the waveform can result in errors during period discrimination, leading to phase tracking misalignment. Such misalignment can correspond to a positional deviation of up to 3 kilometers.]

Comments 13: *[this is too long. suggest add a "discussion" section, and make conclusion on your contribution.]*

Response 13: *Thank you for pointing this out. We agree with this comment.*

[It has been carefully revised in the original manuscript.]

Revised manuscript:

firm the effectiveness of the proposed method. Finally, **Section 5** summarizes the findings 97
of the paper. **Section 6** summarizes the contributions of the paper. 98

5. Conclusions 542

This paper analyzes the time-frequency domain characteristics of eLoran and pro- 543