UNITED STATES PATENT AND TRADEMARK OFFICE

NOTICE OF ALLOWANCE AND FEE(S) DUE

21874   7590   08/25/2020

LOCKE LORD LLP
P.O. BOX 55874
BOSTON, MA 02205

EXAMINER
LAU, TUNG S

ART UNIT	PAPER NUMBER
2862	

DATE MAILED: 08/25/2020

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/930,741	07/16/2020	Zhipeng WANG	0127582.167US2	1548

TITLE OF INVENTION: GLOBAL IONOSPHERIC TOTAL ELECTRON CONTENT PREDICTION SYSTEM

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	SMALL	$500	$0.00	$0.00	$500	11/25/2020

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

HOW TO REPLY TO THIS NOTICE:

I. Review the ENTITY STATUS shown above. If the ENTITY STATUS is shown as SMALL or MICRO, verify whether entitlement to that entity status still applies.

If the ENTITY STATUS is the same as shown above, pay the TOTAL FEE(S) DUE shown above.

If the ENTITY STATUS is changed from that shown above, on PART B - FEE(S) TRANSMITTAL, complete section number 5 titled "Change in Entity Status (from status indicated above)".

For purposes of this notice, small entity fees are 1/2 the amount of undiscounted fees, and micro entity fees are 1/2 the amount of small entity fees.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed and an extra copy of the form should be submitted. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Maintenance fees are due in utility patents issuing on applications filed on or after Dec. 12, 1980. It is patentee's responsibility to ensure timely payment of maintenance fees when due. More information is available at www.uspto.gov/PatentMaintenanceFees.

PTOL-85 (Rev. 02/11)

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), by mail or fax, or via EFS-Web.

By mail, send to: Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

By fax, send to: (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

| 21874 | 7590 | 08/25/2020 |

LOCKE LORD LLP
P.O. BOX 55874
BOSTON, MA 02205

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission
I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being transmitted to the USPTO via EFS-Web or by facsimile to (571) 273-2885, on the date below.

	(Typed or printed name)
	(Signature)
	(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/930,741	07/16/2020	Zhipeng WANG	0127582.167US2	1548

TITLE OF INVENTION: GLOBAL IONOSPHERIC TOTAL ELECTRON CONTENT PREDICTION SYSTEM

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	SMALL	$500	$0.00	$0.00	$500	11/25/2020

EXAMINER	ART UNIT	CLASS-SUBCLASS
LAU, TUNG S	2862	702-003000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

❏ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.

❏ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-09 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 _____

2 _____

3 _____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document must have been previously recorded, or filed for recordation, as set forth in 37 CFR 3.11 and 37 CFR 3.81(a). Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE   (B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent) : ❏ Individual ❏ Corporation or other private group entity ❏ Government

4a. Fees submitted: ❏ Issue Fee   ❏ Publication Fee (if required)   ❏ Advance Order - # of Copies _____

4b. Method of Payment: *(Please first reapply any previously paid fee shown above)*

❏ Electronic Payment via EFS-Web   ❏ Enclosed check   ❏ Non-electronic payment by credit card (Attach form PTO-2038)

❏ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment to Deposit Account No. _____

5. **Change in Entity Status** (from status indicated above)

❏ Applicant certifying micro entity status. See 37 CFR 1.29

❏ Applicant asserting small entity status. See 37 CFR 1.27

❏ Applicant changing to regular undiscounted fee status.

NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.
NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.
NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature _____   Date _____

Typed or printed name _____   Registration No. _____

UNITED STATES PATENT AND TRADEMARK OFFICE

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/930,741	07/16/2020	Zhipeng WANG	0127582.167US2	1548

21874 7590 08/25/2020		EXAMINER
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BOSTON, MA 02205	ART UNIT	PAPER NUMBER
	2862	

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Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(Applications filed on or after May 29, 2000)

The Office has discontinued providing a Patent Term Adjustment (PTA) calculation with the Notice of Allowance.

Section 1(h)(2) of the AIA Technical Corrections Act amended 35 U.S.C. 154(b)(3)(B)(i) to eliminate the requirement that the Office provide a patent term adjustment determination with the notice of allowance. See Revisions to Patent Term Adjustment, 78 Fed. Reg. 19416, 19417 (Apr. 1, 2013). Therefore, the Office is no longer providing an initial patent term adjustment determination with the notice of allowance. The Office will continue to provide a patent term adjustment determination with the Issue Notification Letter that is mailed to applicant approximately three weeks prior to the issue date of the patent, and will include the patent term adjustment on the patent. Any request for reconsideration of the patent term adjustment determination (or reinstatement of patent term adjustment) should follow the process outlined in 37 CFR 1.705.

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

PTOL-85 (Rev. 02/11)

OMB Clearance and PRA Burden Statement for PTOL-85 Part B

The Paperwork Reduction Act (PRA) of 1995 requires Federal agencies to obtain Office of Management and Budget approval before requesting most types of information from the public. When OMB approves an agency request to collect information from the public, OMB (i) provides a valid OMB Control Number and expiration date for the agency to display on the instrument that will be used to collect the information and (ii) requires the agency to inform the public about the OMB Control Number's legal significance in accordance with 5 CFR 1320.5(b).

The information collected by PTOL-85 Part B is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 30 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450. Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:
1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☑ This communication is responsive to 07/16/2020.

   ☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2. ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

3. ☑ The allowed claim(s) is/are 1-7 . As a result of the allowed claim(s), you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see **http://www.uspto.gov/patents/init_events/pph/index.jsp** or send an inquiry to **PPHfeedback@uspto.gov.**

4. ☑ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

   Certified copies:

   a) ☑ All   b) ☐ Some   *c) ☐ None of the:

      1. ☑ Certified copies of the priority documents have been received.
      2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
      3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____ .

   Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application. **THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.**

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.

   ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____ .

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☑ Notice of References Cited (PTO-892)
2. ☐ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date _____ .
3. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material _____ .
4. ☐ Interview Summary (PTO-413), Paper No./Mail Date. _____ .

5. ☐ Examiner's Amendment/Comment
6. ☑ Examiner's Statement of Reasons for Allowance
7. ☐ Other _____ .

/TUNG S LAU/
Primary Examiner, Art Unit 2862

Notice of Pre-AIA or AIA Status

The present application, filed on or after March 16, 2013, is being examined

under the first inventor to file provisions of the AIA.

DETAILED ACTION

PRIORITIZED EXAMINATION UNDER 37 CFR 1.102(e)

1.   TrackOne Request Granted on 07/29/2020.

Citation of Relevant Prior Art

2.   The prior art made of record and not relied upon is considered pertinent to

applicant's disclosure. See MPEP 707.05. Although the prior art discloses

several claimed limitation, for example:

TOBISKA (US Patent Application Publication 2006/0229813) describes the

system has a four-dimensional variational and a recursive Kalman filter. Global

assimilative ionospheric model estimates driver model's weather behavior that

satisfy requirements of minimizing differences between observations such as

line-of-sight total electron content on regional or global scales and predicted

observations based on the ionospheric model state. The corrected driver model's

outputs are used to drive an ionospheric model forward in time to generate

forecasts for next few hours. The filter adjusts the ionospheric forward model

state by weighting the corrected model results.

DEL CASTILLO et al. (US Patent Application Publication 2013/0021201)

describes involves selecting a region of interest, and retrieving historical

ionosphere data for the selected region of interest. Predictions of ionospheric

delays are generated (306) for the selected region based on the historical

ionosphere data. The predictions of ionospheric delays are fit (308) to a standard

Global Positioning System (GPS) ionosphere model to generate a predictive

ionosphere model for the selected region. The predictive ionosphere model is

stored (310) in a database i.e. crystal dynamics data information system (CDDIS)

database.

MEMARZADEH (US Patent 10,551,505) describes measuring phase scintillation

data for earth-orbiting satellites (12A) and reference stations (10A-10D) during

multiple epochs (t, t-1, t-2, t+k). An expected phase scintillation value is

forecasted for each satellite and reference station for a period of 24 hours based

on a cyclical prediction model. The expected phase scintillation values of the

reference stations are spatially interpolated to determine a predicted phase

scintillation index for a given user location (20) and a given satellite. The

interpolation step is repeated for satellites visible from user location.

GOELTNER et al. (US Patent Application Publication 2019/0129038) describes

sensor that scans surroundings of the monitoring system and provides sensor

data. The sensor has a light source, a light detector and light guides guiding light

from the light source and to the light detector. The light guide ends at different

outputs. The control device provides data about an object in the surroundings

based on the sensor data and determines a class of risk of the object based on

the sensor data. An alert device is coupled with the control device and outputs an

alert signal dependent on the determined class of risk. An information device

provides information about a condition of the surroundings. The condition of the

surroundings includes one of weather information or traffic information. The

control device is configured to determine the class of risk dependent on the

information.

Lin (US Patent 6,205,400)describes vehicle positioning and data integrating

process and system can substantially solve the problems encountered in

avionics system integration, which employs integrated global positioning

system/inertial measurement unit enhanced with altitude measurements to derive

vehicle position, velocity, attitude, and body acceleration and rotation information.

A vehicle positioning and data integrating system comprises navigation sensors

and an IMU interface and preprocessing board, an altitude interface and

processing board, a navigation processing board, a shared memory card, a bus

arbiter, a control board, and a bus interface. The control board distributes

navigation data to flight management system, flight control system, automatic

dependent aurveillance, cockpit display, enhanced ground proximity warning

system, weather radar, and satellite communication system.

Lin (US Patent 6,246,960) describes system with altitude measurement includes

the steps of receiving the inertial measurements from an inertial sensor, the

global positioning system raw measurements from a global positioning system

processor, and the altitude measurement from an altitude measurement device

and performing integrated filtering, feeding the velocity and acceleration back to the global positioning system satellite signal tracking loops, and using integration solution to aid the global positioning system satellite signal carrier phase ambiguity resolution. The present invention provides a positioning method and system with high accuracy and robustness. The global positioning system measurements assure the long term positioning accuracy and the inertial measurements assure the short term positioning accuracy. The altitude measurement improves the vertical positioning accuracy. The velocity and acceleration from the inertial device aid the global positioning system signal tracking. The integrated positioning solution is employed to derive the global positioning system carrier phase ambiguity number. The present patent supports high precision navigation in general aviation and space applications. It also supports high precision approach and landing for aircraft, reusable launch vehicles, and other air transportation vehicles.

Lin (US Patent 6,167,247) describes vehicle positioning process and system thereof can substantially solve the problems encountered in global positioning system-only and inertial navigation system-only, such as loss of global positioning satellite signal, sensibility to jamming and spoofing, and inertial solution's drift over time, in which the velocity and acceleration from an inertial navigation processor are used to aid the code and carrier phase tracking of the global positioning system satellite signals, so as to enhance the performance of the global positioning and inertial integration system, even in heavy jamming and

high dynamic environments. The improved fully-coupled GPS/IMU vehicle

positioning system includes an IMU (inertial measurement unit) and a GPS

processor which are connected to a central navigation processor to produce

navigation solution that is output to an I/O (input/output) interface.

Intriligator et al. (US Patent 7,096,121) describes (1) a template-based

embodiment, (2) an expert system-based embodiment, and (3) a neural network

based embodiment. The template-based embodiment predicts space weather

based on a comparison of current SEP data (and other solar, interplanetary, or

geophysical data of interest) with historically derived "templates," each containing

three or more SEP data measurements (and other data of interest) associated

with the presence or absence of a particular type of space weather event.

Separate templates are provided, where appropriate, for different recent and/or

cyclic variations in solar, interplanetary, or geophysical activity, such as, but not

limited to, variations associated with the phase of the solar cycle. The expert

system-based embodiment predicts space weather based on a set of rules that

identify patterns in SEP data comprising three or more data points. Such patterns

include, for example, (i) a peak in SEP data and (ii) a steep rise or peak in x-rays

followed by a steep rise or peak in SEPs. Again, separate rules are provided,

where appropriate, for recent and/or cyclic variations in solar, interplanetary, or

geophysical activity. The neural network embodiment predicts space weather

based on the input of three or more current SEP data values, possibly together

with solar, interplanetary, or geophysical activity data values, and, where

appropriate, information regarding recent and/or cyclic variations in solar,

interplanetary, or geophysical activity. It is trained with data from quiet weather

states as well as stormy states and, where appropriate, it can be trained with

information regarding recent and/or cyclic variations in solar, interplanetary, or

geophysical activity. Alternatively, where appropriate, separate neural networks

may be used for different phases associated with recent and/or cyclic variations

in activity.

Senzhang Wang in Deep Learning for Spatio-Temporal Data Mining: A

Survey, 21 pages, 24, June 2019 describes Spatio-temporal data mining (STDM)

is becoming growingly important in the big data era with the increasing

availability and importance of large spatio-temporal datasets such as maps,

virtual globes, remote-sensing images, the decennial census and GPS

trajectories. STDM has broad applications in various domains including

environment and climate (e.g. wind prediction and precipitation forecasting),

public safety (e.g. crime prediction), intelligent transportation (e.g. traffic flow

mining), etc. Classical data mining techniques that are used to deal with

transaction data or graph data often perform poorly when applied to spatio-

temporal datasets because of many reasons. First, ST data are usually

embedded in continuous space, whereas classical datasets such as transactions

and graphs are often discrete. Second, patterns of ST data usually present both

spatial and temporal properties, which is more complex and the data correlations

are hard to capture by traditional methods. Finally, one of the common

assumptions in traditional statistical based data mining methods is that

data samples are independently generated. When it comes to the analysis of

spatio-temporal data, however, the assumption about the independence of

samples usually does not hold because ST data tends to be highly self

correlated.

Yuan Yunbin in Monitoring the ionosphere based on the Crustal Movement

Observation Network of China, 8 pages, 11 April, 2015, describes IGS delivers

the satellite orbit and clock final products on a regular basis. Additionally, the GPS

receivers serving as ionosphere sensors are commonly deployed at stationary

locations with either known or unknown positions. With these general facts in

mind, we retrieve the IO using the precise point-positioning (PPP) technique [15-

17]. Importantly, unlike the customary PPP that categorizes the ionospheric

delays as nuisance unknowns and removes them by forming ionosphere-free

observables, our PPP employs the original (uncombined) GNSS data and

parameterizes the IO as one type of estimable unknown. The geometric

unknowns involved in the PPP are all receiver-dependent and are much

smaller than the line-of-sight unknowns handled by the carrier-to-code leveling.

Using experimental dual-frequency GNSS data collected by a variety of zero- and

short-baseline setups deployed worldwide, we comparatively assess the quality of

the IO offered by the carrier-to-code leveling and the PPP techniques.

Tae San Kim in Graph convolutional network approach applied to predict hourly

bike-sharing demands considering spatial, temporal, and global effects, 16

pages, September 16, 2019, describes Bike data has both spatial and temporal

properties. To improve prediction accuracy, it is important to understand both

characteristics [5]. First, spatial properties indicate dependencies among

stations. The inter-station relationship can be represented by geographical

distances among stations. Furthermore, close stations are more similar than

distant stations, according to the first law of geography [6]. For instance, if one

station does not have any available bikes, the user will most likely rent one at a

nearby station. However, the relationship among stations is not merely

established by local distance. Another connection can be construed in terms of

usage patterns. The mobility pattern of bike usage can be identified by

usage pattern and can be utilized for forecasting upcoming demand [7]. For

example, we should expect greater usages between residential stations and

commercial stations, especially during rush-hour commute. These two types of

stations are considered closely related, despite their distance. Second, from the

temporal perspective, demand is not only influenced by temporal proximity, but

also by repetitive patterns over a constant period [8]. For example, daily

and weekly patterns can be employed to forecast future demand. Thus, these

various temporal properties are just as important as spatial properties.

Claudio Cesaroni in Neural network based model for global Total Electron

Content Forecasting, 18 pages, 6 March 2020, describes Short-term vTEC

forecasting by empirical approaches are adopted and implemented in regional as

well as in global services. Among the others, the Space Weather Application

Center Ionosphere (SWACI) provides in real time vTEC forecast one

hour in advance over Europe as well and at global scale

(https://impc.dlr.de/products/total-electron-content/forecast-tec/).

The empirical approach is based on the Neustrelitz TEC Model (NTCM)

(Jakowski et al., 2011), a polynomial model consisting of linear terms used as

background model. The forecasted map results as a sum of the actual vTEC map

and a weighted sum of the temporal vTEC gradient of the previous hour and the

temporal gradient of the previous day at the same time. The NCTM

and other empirical models have been recently tested over Europe revealing the

NCTM capability to extend the forecast up to 24 h in advance under quiet

geospatial conditions (Badeke et al., 2018).

Still within operational services, the International GNSS Service (IGS) releases

actual high valuable vTEC global maps in the form of different products (rapid

and final products, https://www.igs.org/products) with variable latency (in near

real-time and/or days after) that users can access for their own purposes. The

GLOBAL Ionospheric Maps (GIM) are based on the joint efforts for GNSS data

processing by the IGS ionospheric working group (Iono-WG) and are available

online since 1998 (Hernández-Pajares et al., 2009). In 2017, Hernandez-Pajares

and co-authors successfully assessed the accuracy of the GIM-UQRG computed

by Universitat Politècnica de Catalunya (UPC) by comparison with external data

from difference of Slant TEC, based on independent global positioning system

data GPS (dSTEC-GPS) and vTEC altimeter (Hernández-Pajares et al., 2017).

Allowable Subject Matter

3.   Claims 1-7 are allowed.

Reasons for Allowance

4.   The following is an examiner's statement of reasons for allowance:

Independent claims 1 and 7 contain allowable subject matter. None of the prior

art of record shows or fairly suggests the claimed invention.

Regarding claim 1:

The primary reason for the allowance of claim 1 is the inclusion of a global

ionospheric total electron content prediction system based on a spatio-temporal

5   sequence hybrid framework, wherein, the system comprises: (b 1)

establishing a hybrid model comprising a model portion A and a model portion B,

wherein firstly, the model portion A is to extract a spatial nonlinear trend of the

non-stationary spatio-temporal sequences by using Convolutional Neural

Networks, extract a temporal nonlinear trend of the non-stationary spatio-

temporal sequence by using a LSTM neural network, and obtain a non-linear

trend model of the non-stationary spatio-temporal sequence by the two

extraction; secondly, a nonlinear trend in data is obtained using the model portion

A, the nonlinear trend in the data is removed to obtain residual data, and

a stationarity test is carried out on the obtained residual data; if the test fails, the

model portion A is readjusted to extract the nonlinear trend again until the

residual data pass the stationarity test; and thirdly, the model portion B is to perform STARMA modeling on stationary residual data if the test is passed; (b2) performing a residual test on a fitting result of the hybrid model; and (b3) after passing the residual test, predicting the global ionospheric total electron content using the hybrid mode, and evaluating the prediction accuracy of the predicted result using the root mean square error (RMS) and average error (Bias). It is these features found in the claim, as they are claimed in the combination and claimed elements arranged as in the claim, that has not been found, taught or suggested by the prior art of record which makes this claim allowable over the prior art.

Claims 2-7 are allowed due to their dependency on claim 1.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Contact information

5.   Any inquiry concerning this communication or earlier communications from the examiner should be directed to Tung S. Lau whose telephone number is 571-272-2274, email is Tungs.Lau@uspto.gov. The examiner can normally be reached on M-F 8-5:30 EDT. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor KUNDU SUJOY, can be reached on

571-272-8586. The fax phone numbers for the organization where this

application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the

Patent Application Information Retrieval (PAIR) system. Status information for

published applications may be obtained from either Private PAIR or Public PAIR.

Status information for unpublished applications is available through Private PAIR

only. For more information about the PAIR system, see http://pair-

direct.uspto.gov. Should you have questions on access to the Private PAIR

system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-

free).

/TUNG S LAU/
Primary Examiner, Art Unit 2862
Technology Center 2800
August 20, 2020

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*	B	US-20130021201-A1	01-2013	del CASTILLO; Manuel	G01S19/071	342/357.59
*	C	US-10551505-B2	02-2020	Memarzadeh; Yahya	G01S19/07	1/1
*	D	US-20190129038-A1	05-2019	Goeltner; Christoph	G08G1/005	1/1
*	E	US-6205400-B1	03-2001	Lin; Ching-Fang	G01C21/165	342/357.31
*	F	US-6246960-B1	06-2001	Lin; Ching-Fang	G01C21/165	701/472
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NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
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	V	Yuan Yunbin, Monitoring the ionosphere based on the Crustal Movement Observation Network of China, 8 pages, 11 April, 2015 (Year: 2015)
	W	Tae San Kim, Graph convolutional network approach applied to predict hourly bike-sharing demands considering spatial, temporal, and global effects, 16 pages, September 16, 2019 (Year: 2019)
	X	Claudio Cesaroni, Neural network based model for global Total Electron Content Forecasting, 18 pages, 6 March 2020 (Year: 2020)

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.