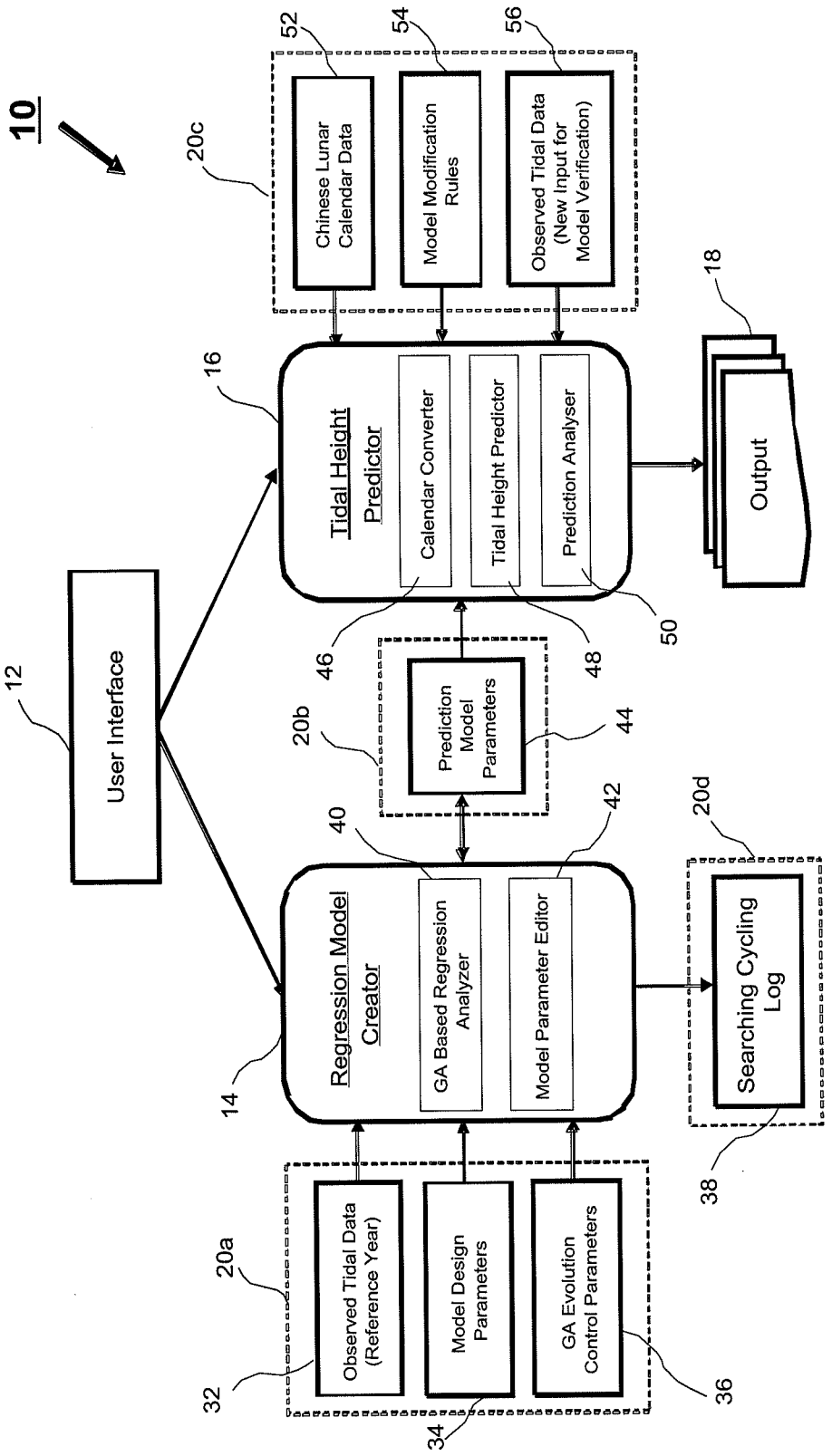

10
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FIG. 1

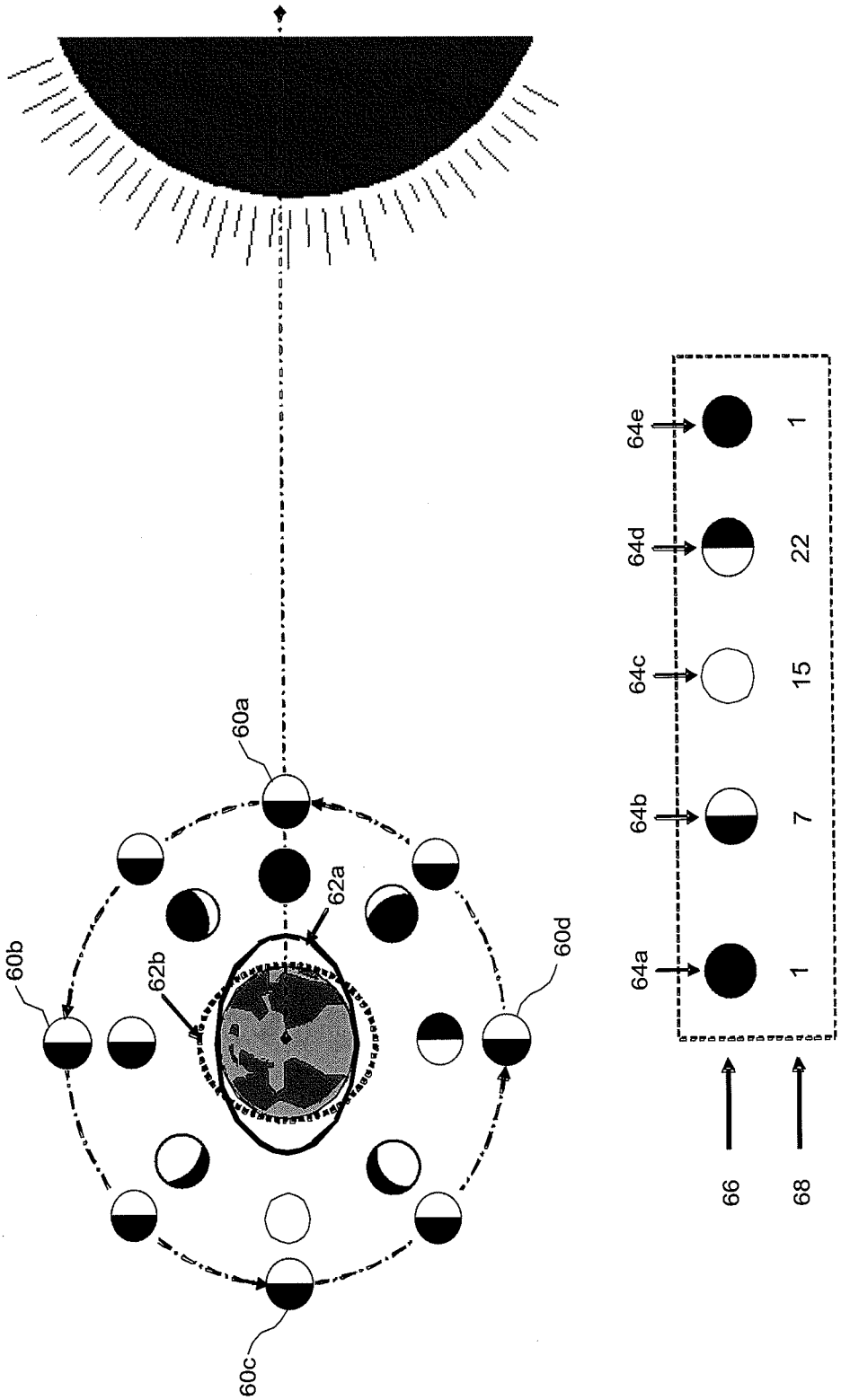
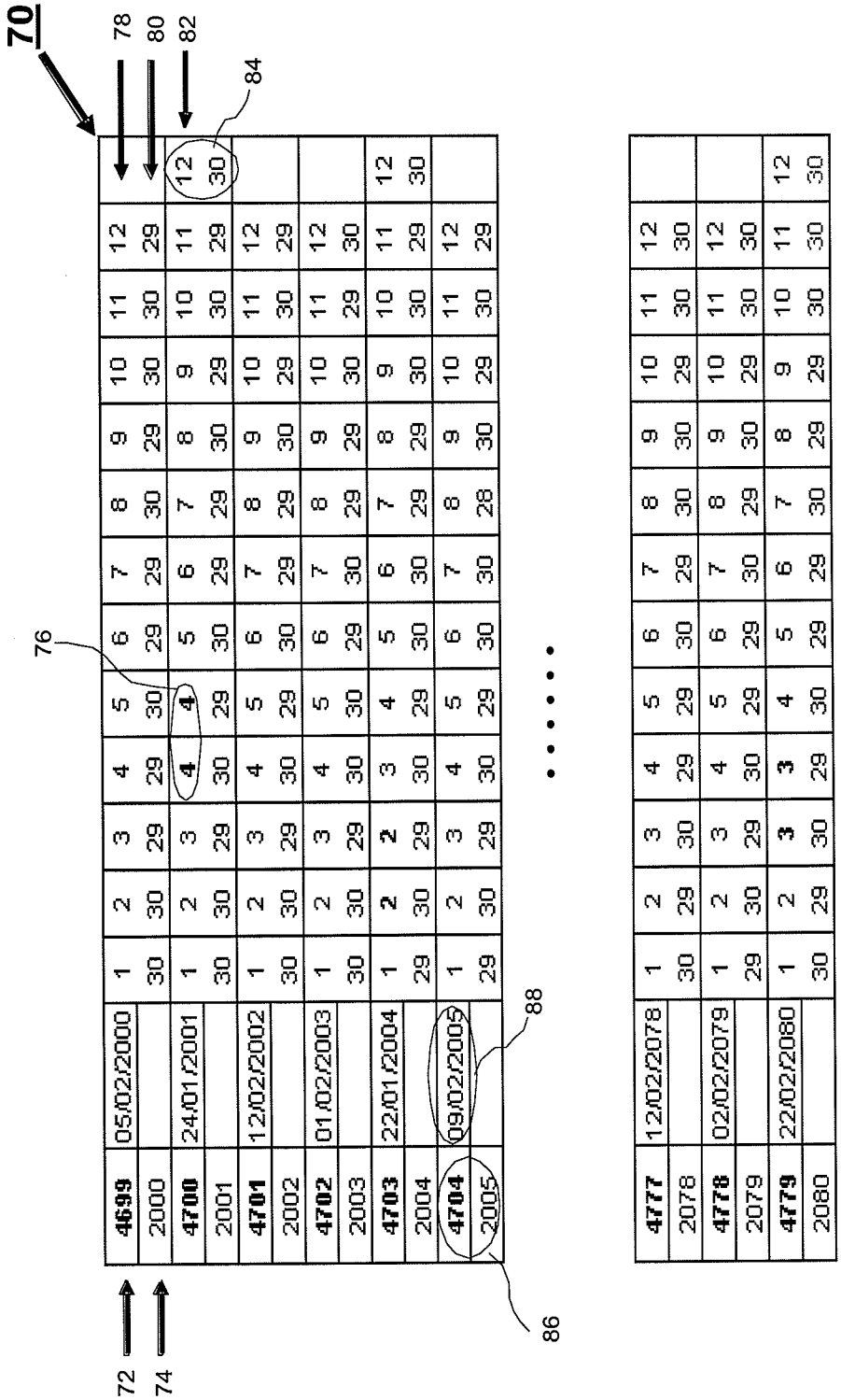


FIG. 2



4699	05/02/2000	1	2	3	4	5	6	7	8	9	10	11	12		
2000		30	30	29	29	30	29	29	30	29	30	30	29		
4700	24/01/2001	1	2	3	4	4	5	6	7	8	9	10	11	12	
2001		30	30	29	30	29	30	29	29	30	29	30	29	30	
4701	12/02/2002	1	2	3	4	5	6	7	8	9	10	11	12		
2002		30	30	29	30	29	30	29	29	30	29	30	29		
4702	01/02/2003	1	2	3	4	5	6	7	8	9	10	11	12		
2003		30	30	29	30	30	29	30	29	29	30	29	30		
4703	22/01/2004	1	2	2	3	4	5	6	7	8	9	10	11	12	
2004		29	30	29	30	29	30	30	29	29	30	30	29	30	
4704	09/02/2005	1	2	3	4	5	6	7	8	9	10	11	12		
2005		29	30	29	30	29	30	30	28	30	29	30	29		

• • • • • •

4777	12/02/2078	1	2	3	4	5	6	7	8	9	10	11	12		
2078		30	29	30	29	29	30	29	30	30	29	30	30		
4778	02/02/2079	1	2	3	4	5	6	7	8	9	10	11	12		
2079		29	30	29	30	29	29	30	29	30	29	30	30		
4779	22/02/2080	1	2	3	3	4	5	6	7	8	9	10	11	12	
2080		30	29	30	29	30	29	29	30	29	29	30	30	30	

FIG. 3

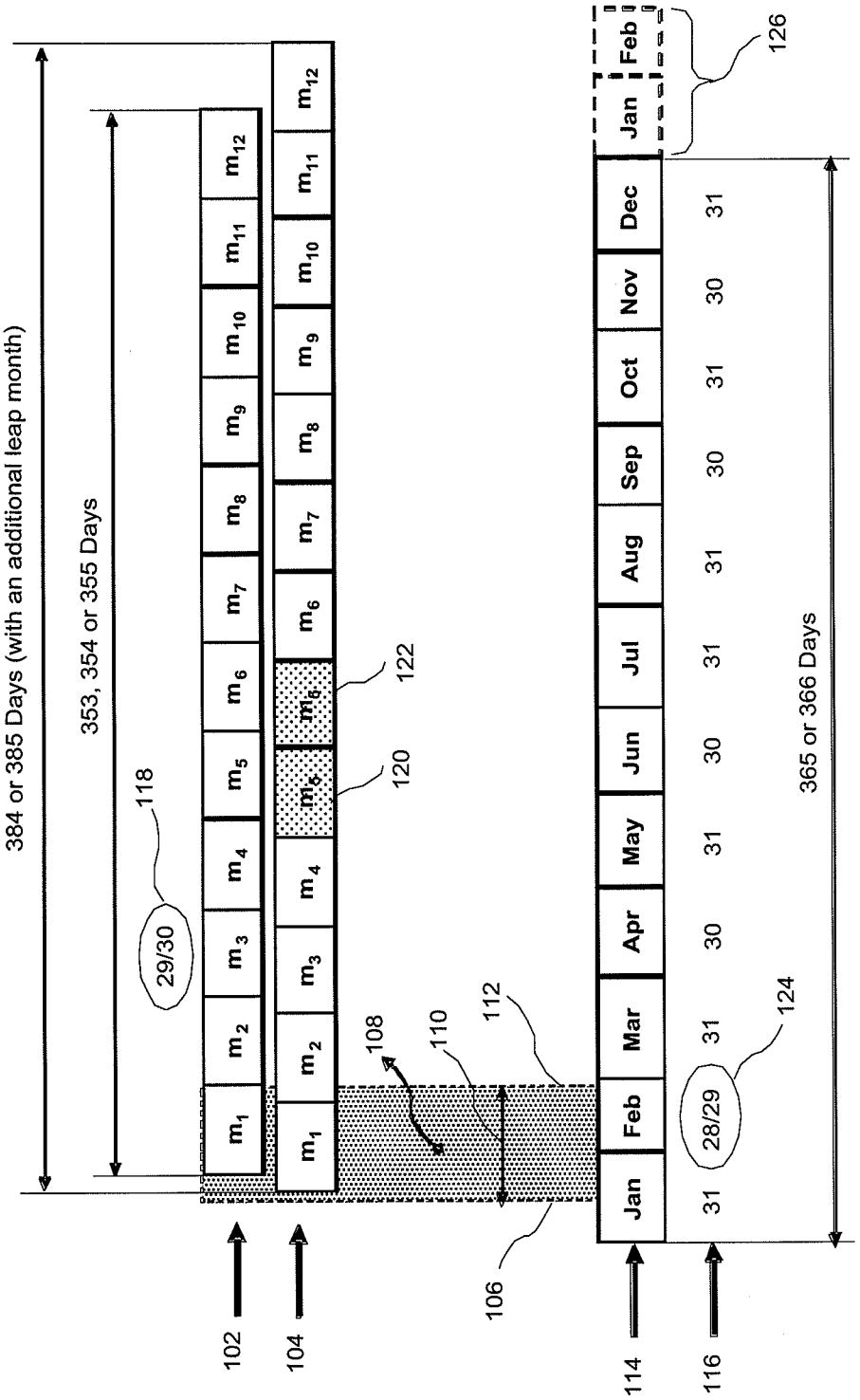

384 or 385 Days (with an additional leap month)
353, 354 or 355 Days
118
29/30
m_1 m_2 m_3 m_4 m_5 m_6 m_7 m_8 m_9 m_{10} m_{11} m_{12}
m_1 m_2 m_3 m_4 m_5 m_6 m_6 m_7 m_8 m_9 m_{10} m_{11} m_{12}
120
122
108
110
112
106
102
104
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
31 28/29 31 30 31 30 31 31 30 31 30 31
124
365 or 366 Days
Jan Feb
126
114
116

FIG. 4

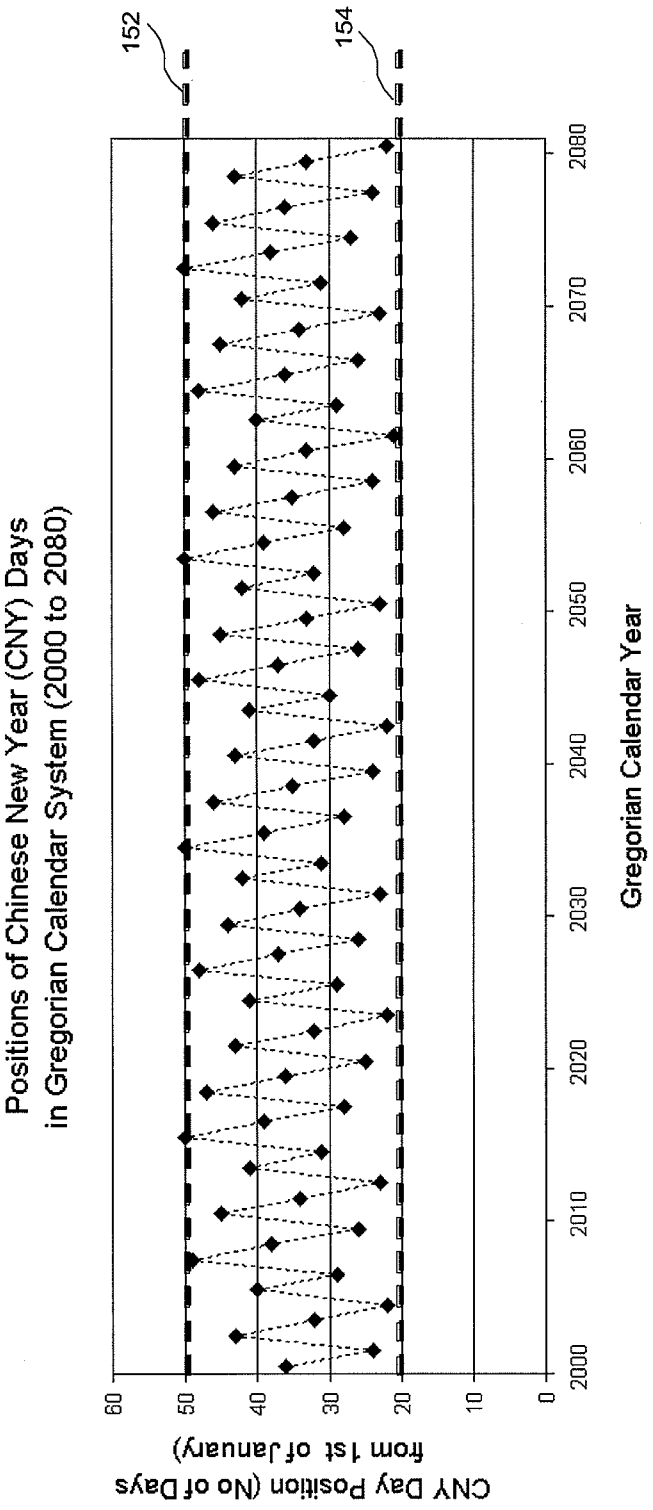

Positions of Chinese New Year (CNY) Days
in Gregorian Calendar System (2000 to 2080)
152
154
CNY Day Position (No of Days
from 1st of January)
60
50
40
30
20
10
0
2000
2010
2020
2030
2040
2050
2060
2070
2080
Gregorian Calendar Year

FIG. 5

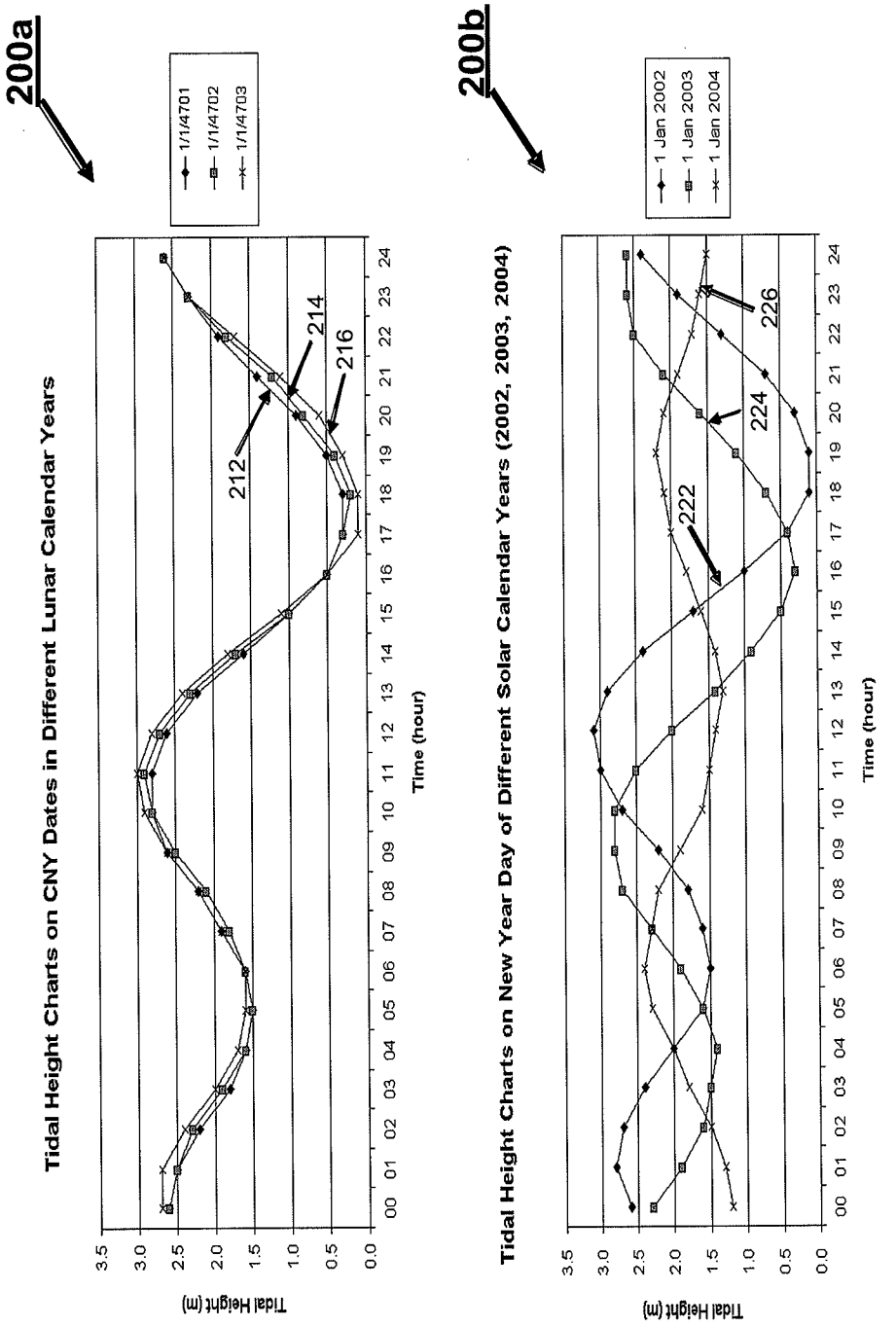

200a
Tidal Height Charts on CNY Dates in Different Lunar Calendar Years
1/1/4701
1/1/4702
1/1/4703
212
214
216
Tidal Height (m)
Time (hour)
200b
Tidal Height Charts on New Year Day of Different Solar Calendar Years (2002, 2003, 2004)
1 Jan 2002
1 Jan 2003
1 Jan 2004
222
224
226
Tidal Height (m)
Time (hour)

FIG. 6

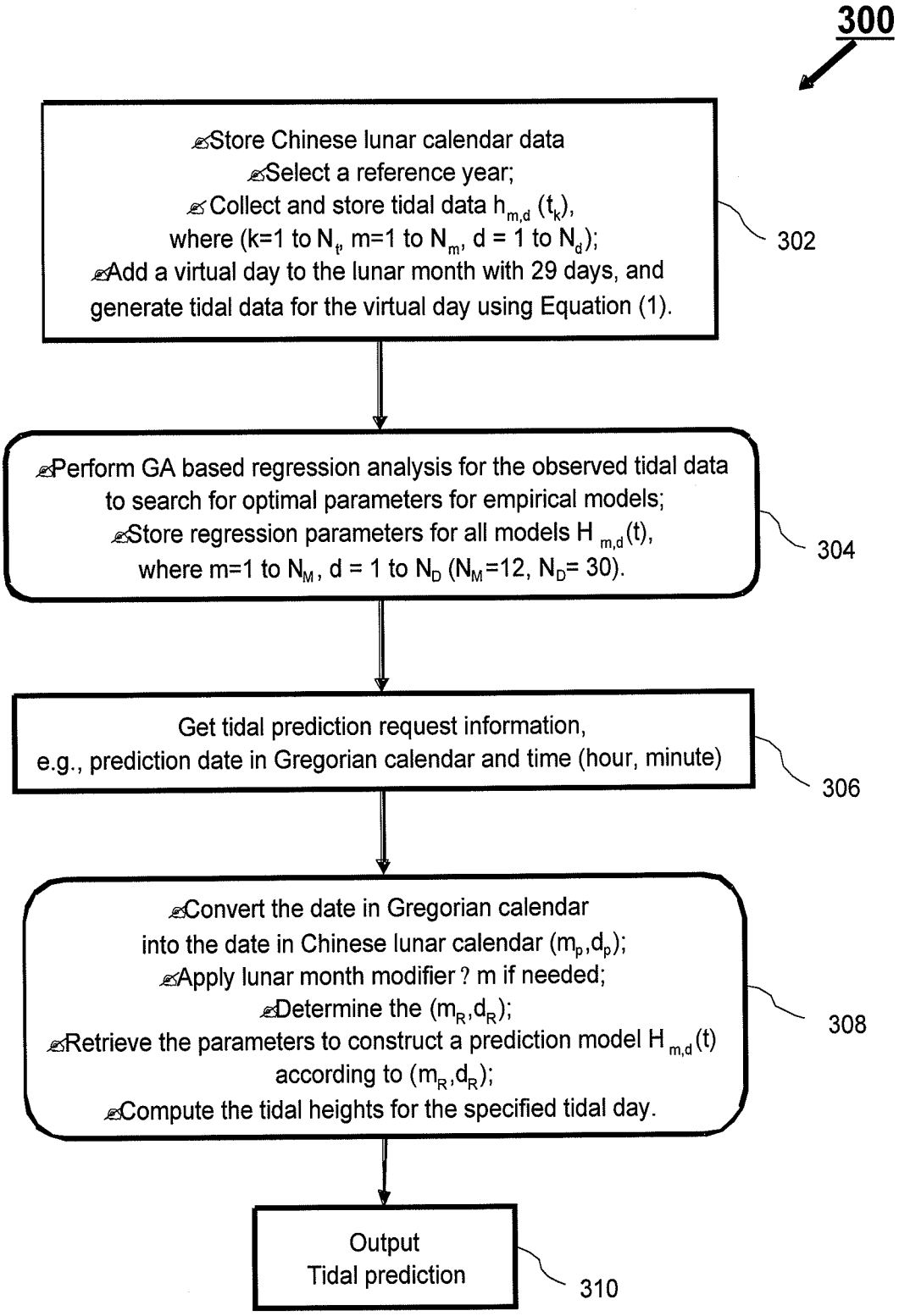

300
Store Chinese lunar calendar data
Select a reference year;
Collect and store tidal data $h_{m,d}(t_k)$,
where (k=1 to N_t, m=1 to N_m, d = 1 to N_d);
Add a virtual day to the lunar month with 29 days, and
generate tidal data for the virtual day using Equation (1).
302
Perform GA based regression analysis for the observed tidal data
to search for optimal parameters for empirical models;
Store regression parameters for all models $H_{m,d}(t)$,
where m=1 to N_M, d = 1 to N_D (N_M=12, N_D= 30).
304
Get tidal prediction request information,
e.g., prediction date in Gregorian calendar and time (hour, minute)
306
Convert the date in Gregorian calendar
into the date in Chinese lunar calendar (m_p,d_p);
Apply lunar month modifier ? m if needed;
Determine the (m_R,d_R);
Retrieve the parameters to construct a prediction model $H_{m,d}(t)$
according to (m_R,d_R);
Compute the tidal heights for the specified tidal day.
308
Output
Tidal prediction
310

FIG. 7

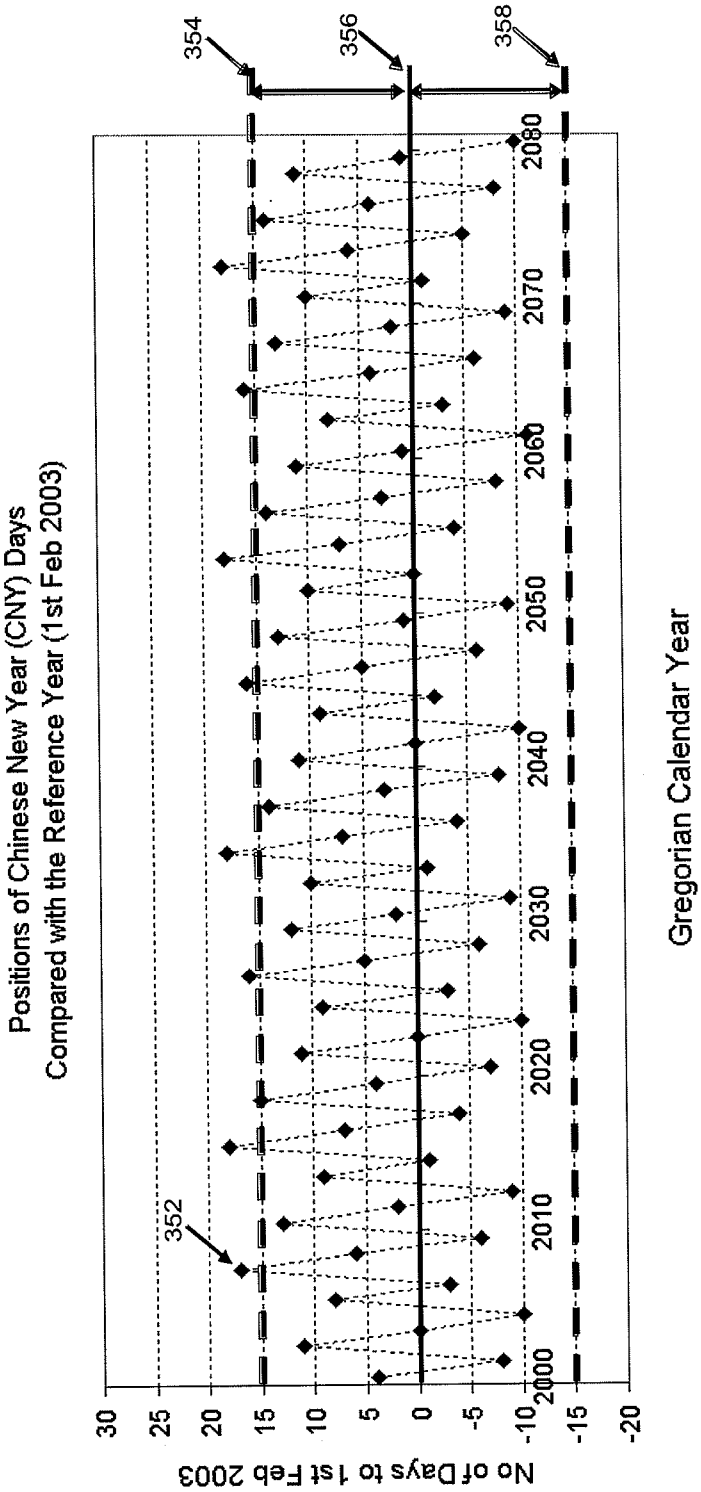

Positions of Chinese New Year (CNY) Days
Compared with the Reference Year (1st Feb 2003)
No of Days to 1st Feb 2003
Gregorian Calendar Year
352
354
356
358
30
25
20
15
10
5
0
-5
-10
-15
-20
2000
2010
2020
2030
2040
2050
2060
2070
2080

FIG. 8

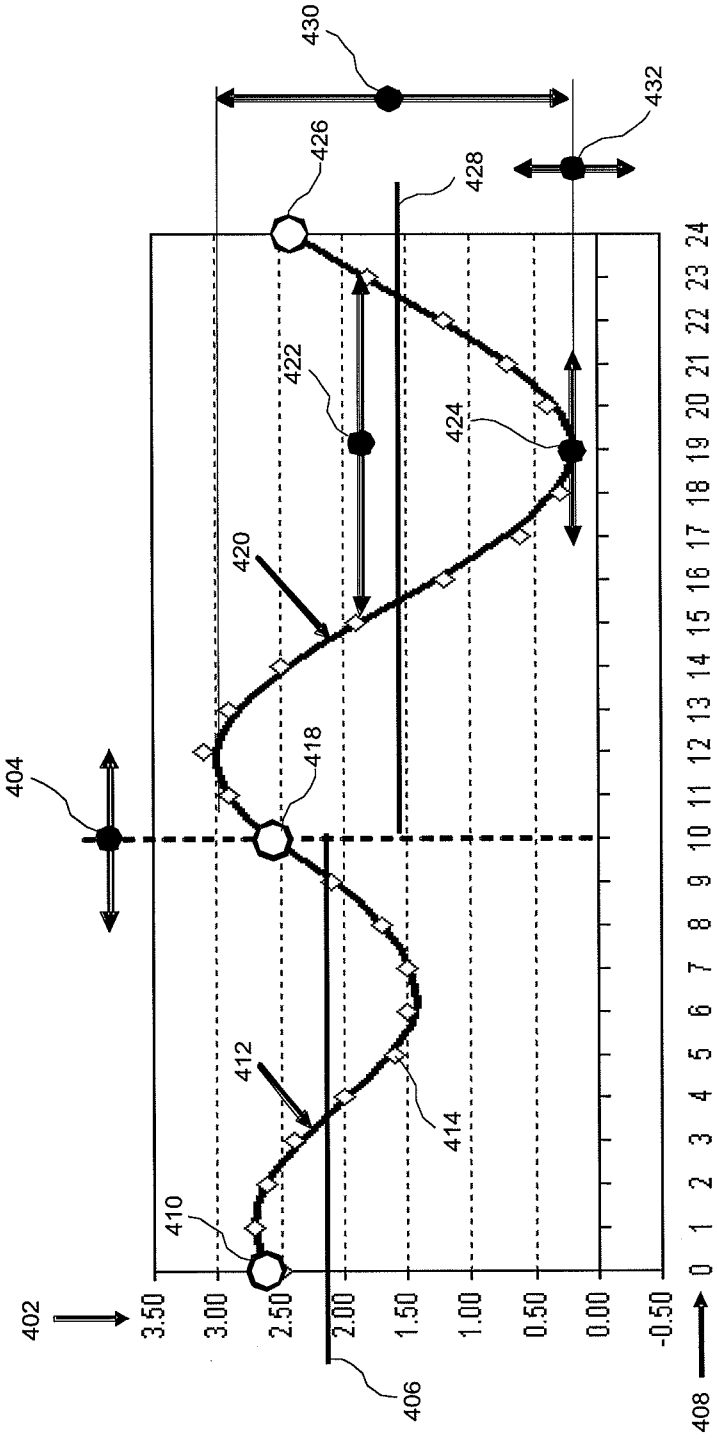

430
432
426
428
422
424
420
418
404
412
414
410
402
406
408
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
-0.50
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24

FIG. 9

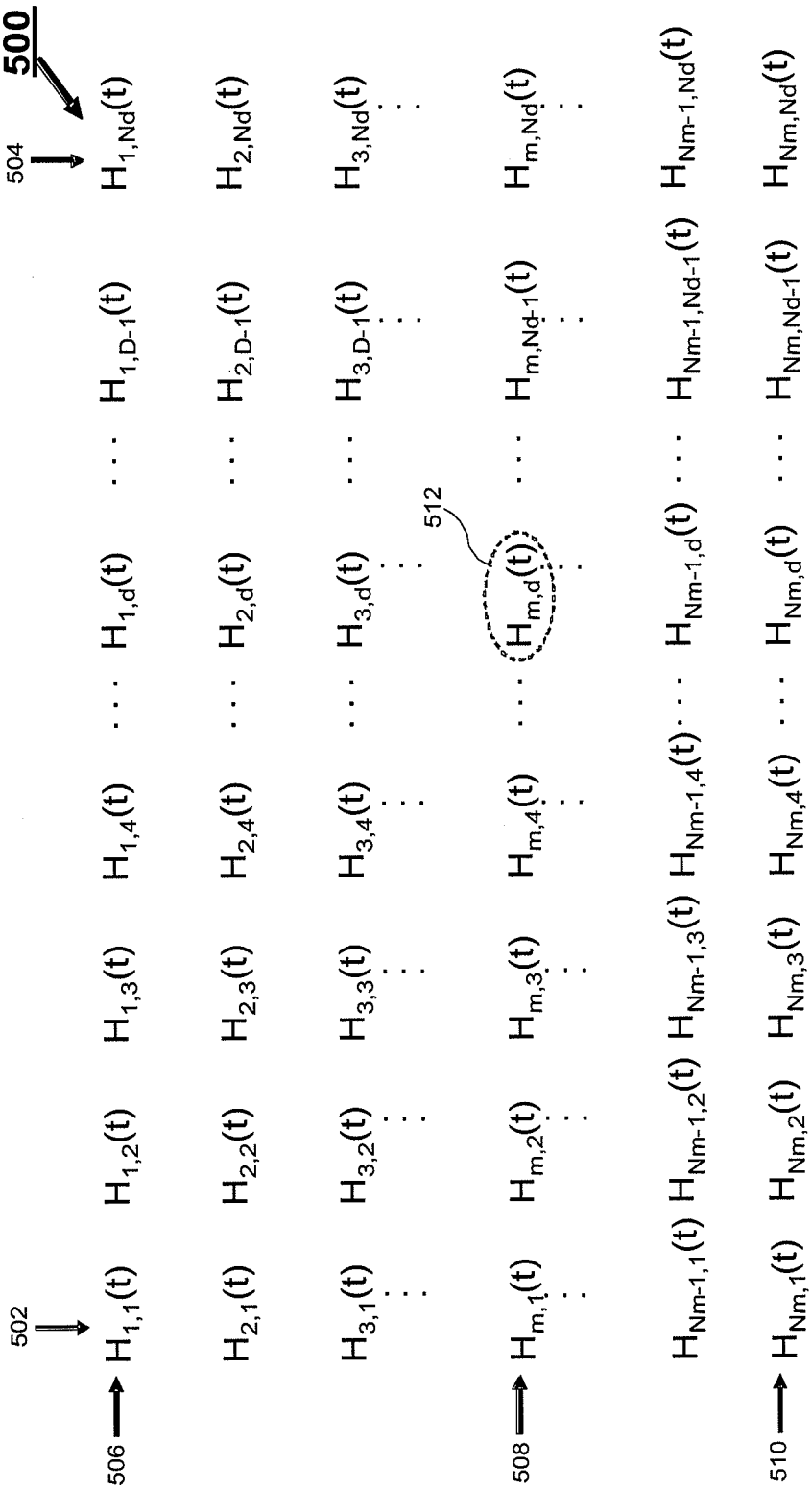

500
502
504
506
508
510
512
$H_{1,1}(t)$ $H_{1,2}(t)$ $H_{1,3}(t)$ $H_{1,4}(t)$ ... $H_{1,d}(t)$ ... $H_{1,D-1}(t)$ $H_{1,Nd}(t)$
$H_{2,1}(t)$ $H_{2,2}(t)$ $H_{2,3}(t)$ $H_{2,4}(t)$ ... $H_{2,d}(t)$ ... $H_{2,D-1}(t)$ $H_{2,Nd}(t)$
$H_{3,1}(t)$ $H_{3,2}(t)$ $H_{3,3}(t)$ $H_{3,4}(t)$ ... $H_{3,d}(t)$ ... $H_{3,D-1}(t)$ $H_{3,Nd}(t)$
$H_{m,1}(t)$ $H_{m,2}(t)$ $H_{m,3}(t)$ $H_{m,4}(t)$ ... $H_{m,d}(t)$ ... $H_{m,Nd-1}(t)$ $H_{m,Nd}(t)$
$H_{Nm-1,1}(t)$ $H_{Nm-1,2}(t)$ $H_{Nm-1,3}(t)$ $H_{Nm-1,4}(t)$ ... $H_{Nm-1,d}(t)$ ... $H_{Nm-1,Nd-1}(t)$ $H_{Nm-1,Nd}(t)$
$H_{Nm,1}(t)$ $H_{Nm,2}(t)$ $H_{Nm,3}(t)$ $H_{Nm,4}(t)$ ... $H_{Nm,d}(t)$ ... $H_{Nm,Nd-1}(t)$ $H_{Nm,Nd}(t)$

FIG. 10

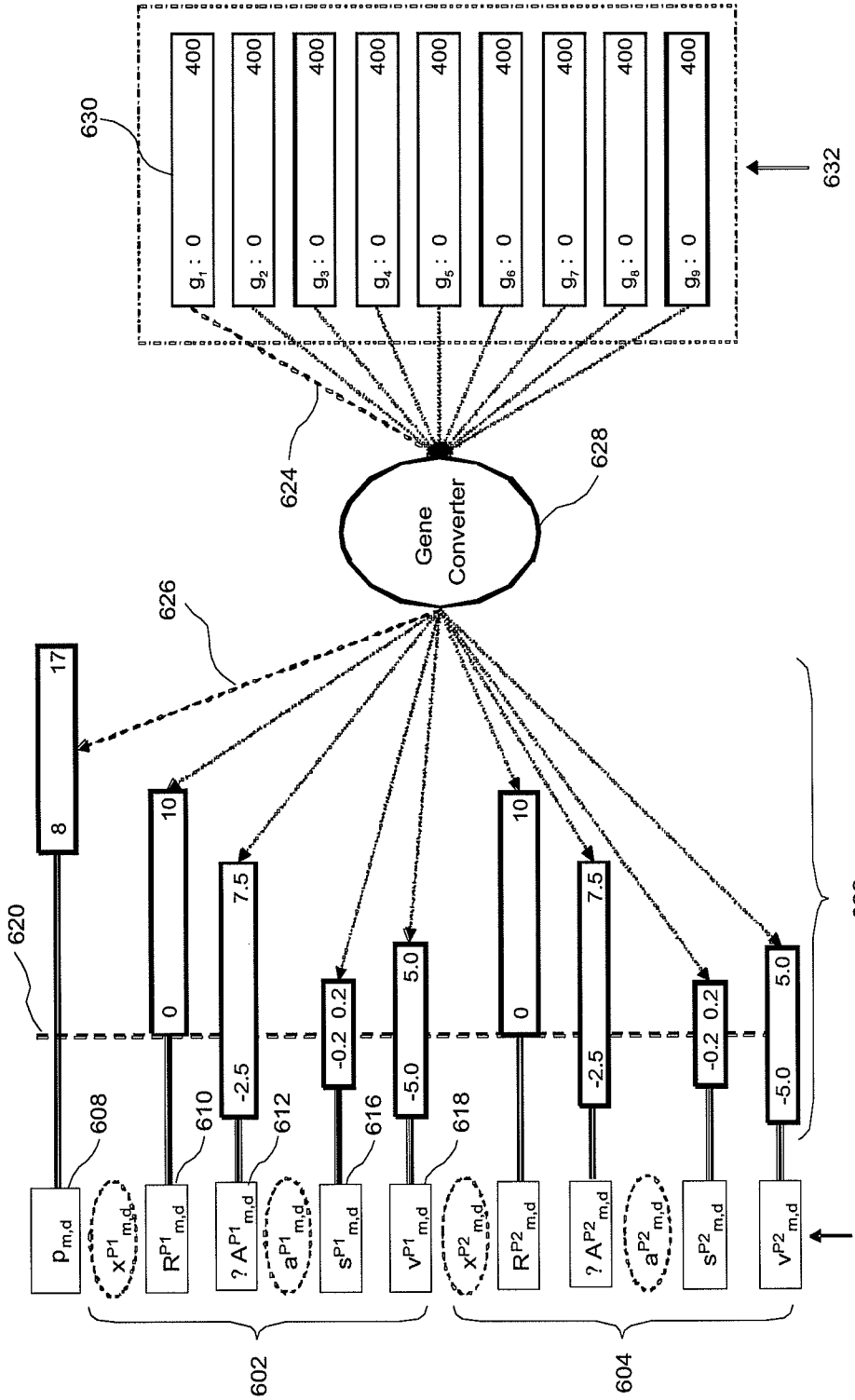

630
632
624
628
Gene Converter
626
620
622
606
602
604
608
610
612
616
618
400
17
8
10
0
7.5
-2.5
0.2
-0.2
5.0
-5.0

FIG. 11

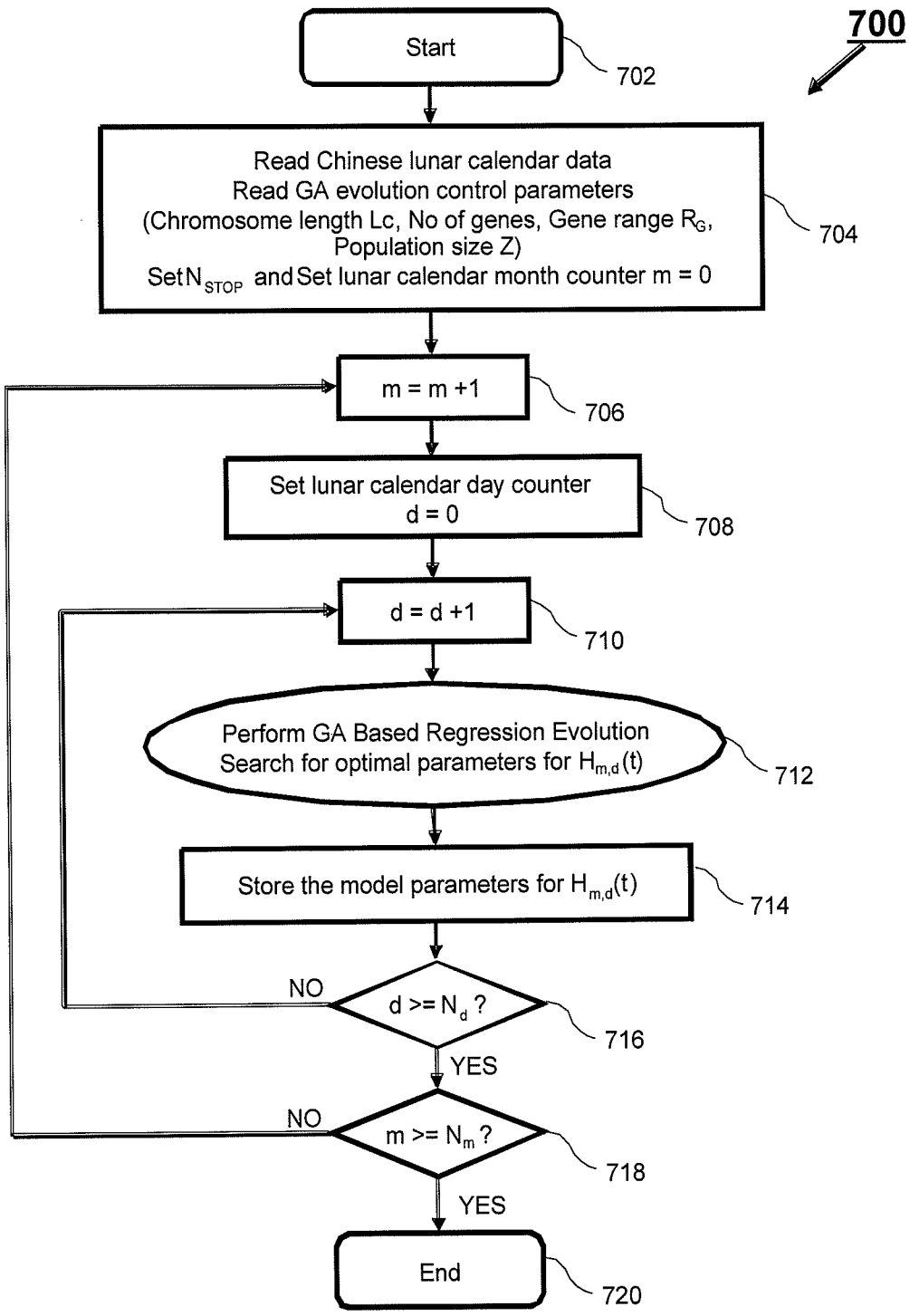

700
Start
702
Read Chinese lunar calendar data
Read GA evolution control parameters
(Chromosome length Lc, No of genes, Gene range R_G,
Population size Z)
Set N_{STOP} and Set lunar calendar month counter m = 0
704
m = m +1
706
Set lunar calendar day counter
d = 0
708
d = d +1
710
Perform GA Based Regression Evolution
Search for optimal parameters for $H_{m,d}(t)$
712
Store the model parameters for $H_{m,d}(t)$
714
NO
d >= N_d ?
716
YES
NO
m >= N_m ?
718
YES
End
720

FIG. 12

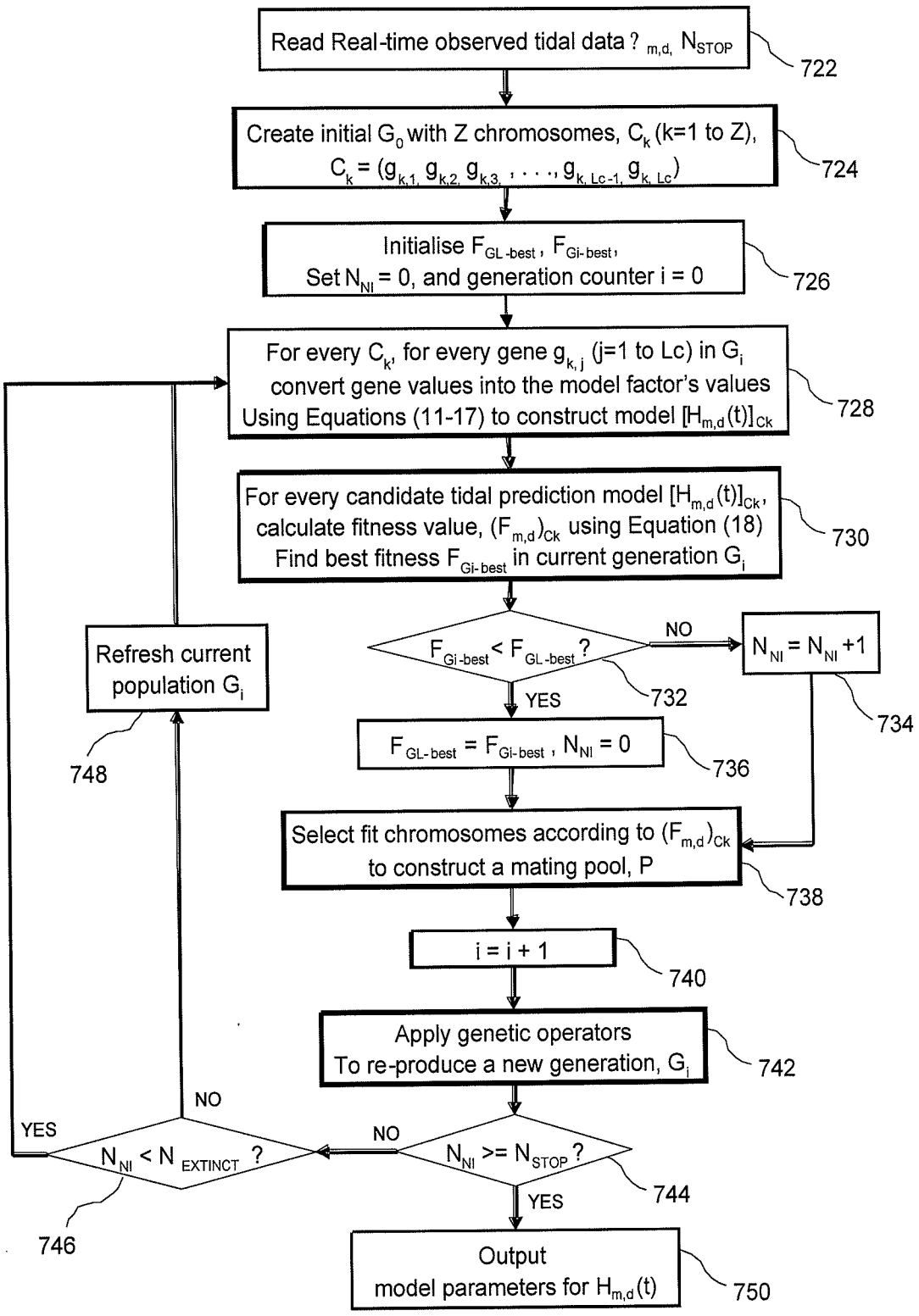

Read Real-time observed tidal data ? m,d, N_STOP
722
Create initial G0 with Z chromosomes, Ck (k=1 to Z),
Ck = (gk,1, gk,2, gk,3, . . ., gk, Lc-1, gk, Lc)
724
Initialise FGL-best , FGi-best ,
Set NNI = 0, and generation counter i = 0
726
For every Ck, for every gene gk, j (j=1 to Lc) in Gi
convert gene values into the model factor's values
Using Equations (11-17) to construct model [Hm,d(t)]Ck
728
For every candidate tidal prediction model [Hm,d(t)]Ck,
calculate fitness value, (Fm,d)Ck using Equation (18)
Find best fitness FGi-best in current generation Gi
730
FGi-best < FGL-best ?
NO
YES
732
NNI = NNI +1
734
Refresh current population Gi
748
FGL-best = FGi-best , NNI = 0
736
Select fit chromosomes according to (Fm,d)Ck
to construct a mating pool, P
738
i = i + 1
740
Apply genetic operators
To re-produce a new generation, Gi
742
NO
YES
NNI < N EXTINCT ?
NO
NNI >= NSTOP ?
744
YES
746
Output
model parameters for Hm,d(t)
750

FIG. 13

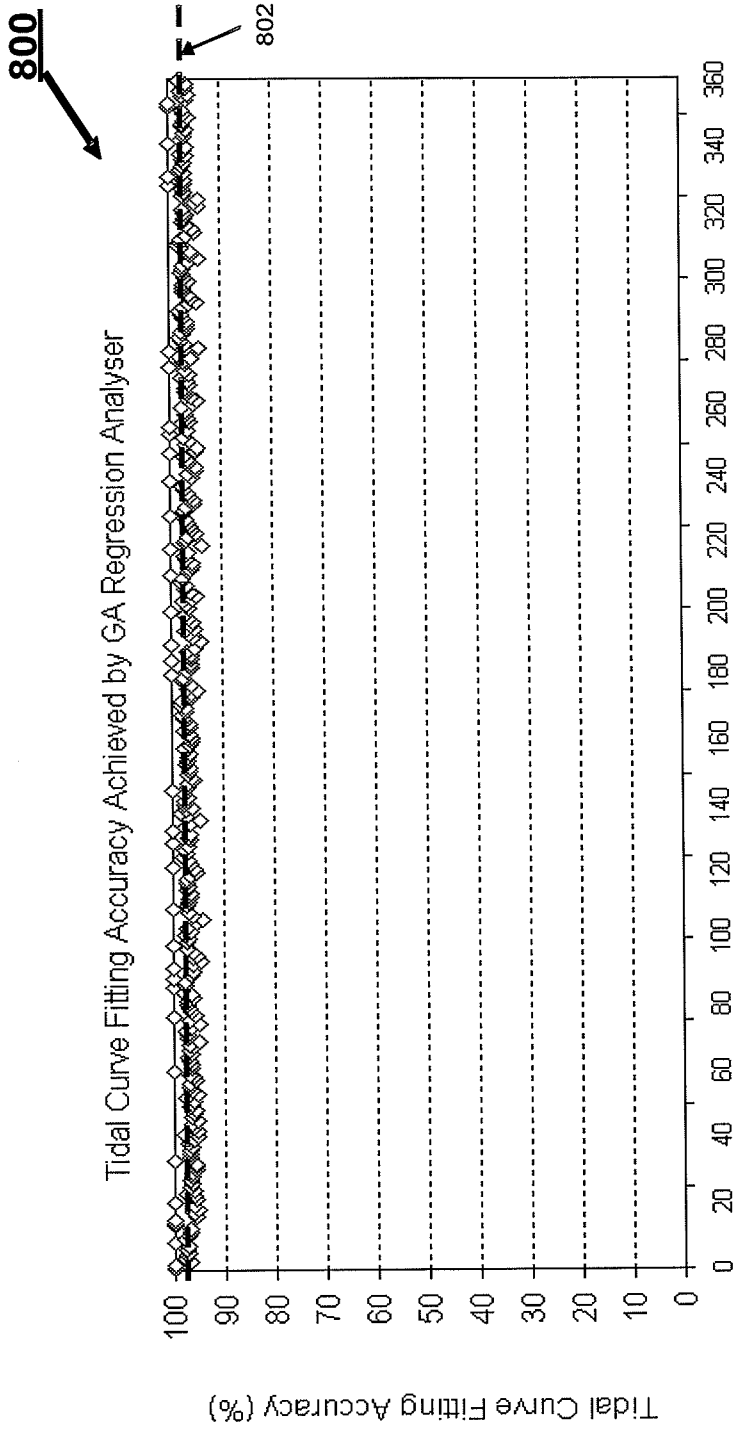

800
802
Tidal Curve Fitting Accuracy Achieved by GA Regression Analyser
Tidal Curve Fitting Accuracy (%)
100
90
80
70
60
50
40
30
20
10
0
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
320
340
360
Tidal Days

FIG. 14

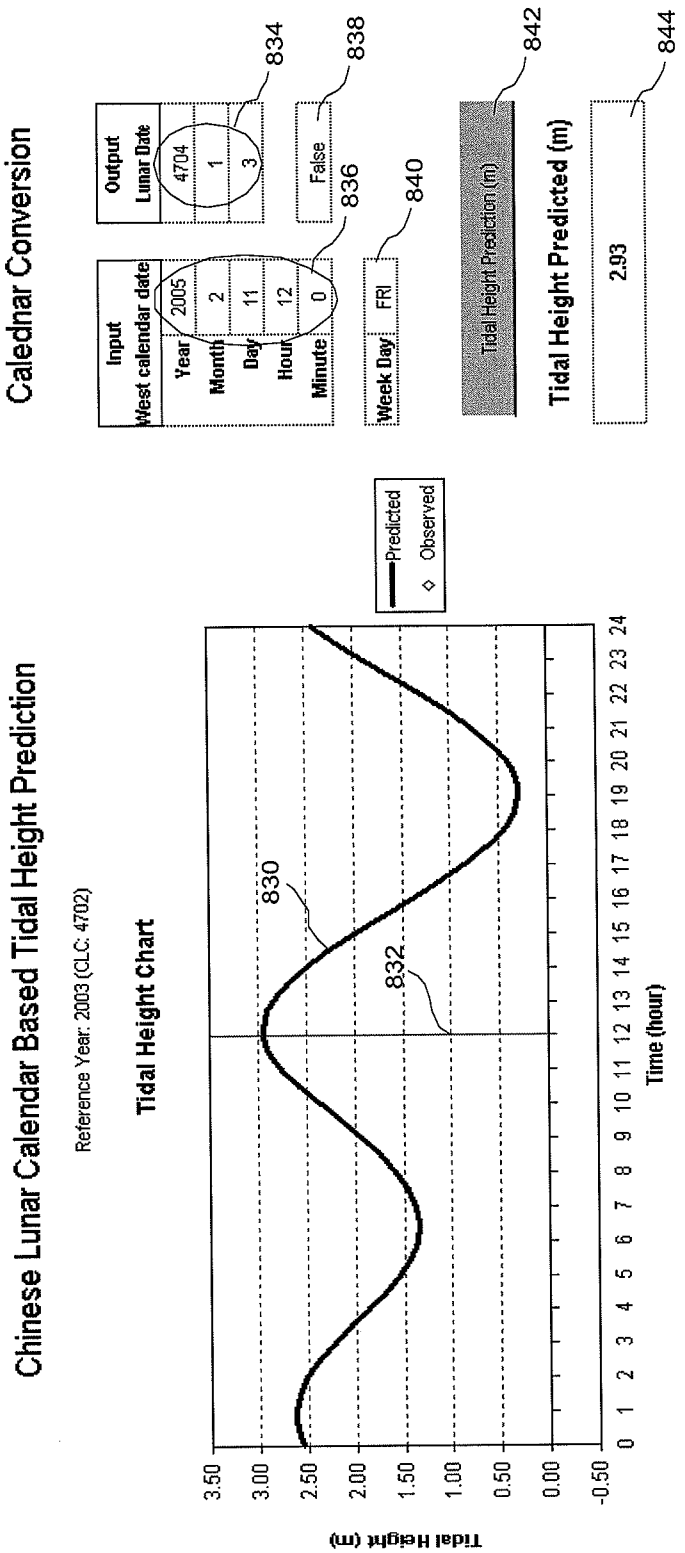

Chinese Lunar Calendar Based Tidal Height Prediction
Reference Year: 2003 (CLC: 4702)
Tidal Height Chart
Predicted
Observed
830
832
Tidal Height (m)
Time (hour)
Calednar Conversion
Input
West calendar date
Year 2005
Month 2
Day 11
Hour 12
Minute 0
Output
Lunar Date
4704
1
3
834
False
838
836
Week Day FRI
840
Tidal Height Prediction (m)
842
Tidal Height Predicted (m)
2.93
844

FIG. 15

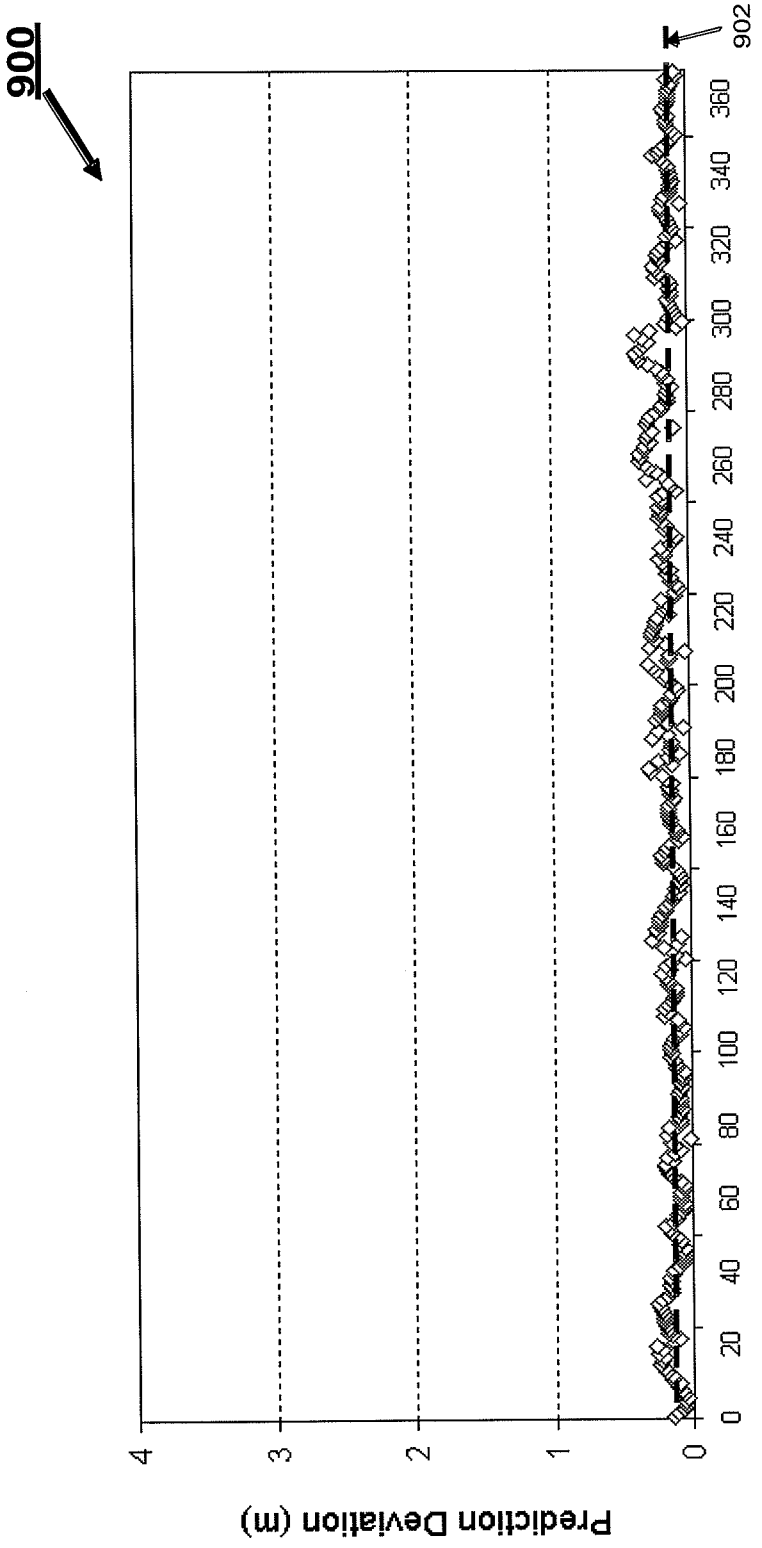

900
902
Prediction Deviation (m)
0
1
2
3
4
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
320
340
360
Days

FIG. 16