DE KUNSTMAAN

In dit nummer o.a.
De NanoVNA
Pulsebreedte modulatie met Arduino
Satelliet baanberekening met Scilab
en nog veel meer

Dear member,

This pdf contains translated articles of our Dutch magazine "De Kunstmaan".
Translation for each article is normally done by the author, using Google Translate (and manual corrections afterwards). But for sure these translations are not perfect! If something isn't clear please let us know.

Formatting is not as perfect as the paper magazine, but figures are all added.

Internet links mentioned in the articles can be found at our website; see under menu 'Weblinks' at:
www.kunstmanen.net

Older magazines, from 2014 to 2018, are now also available in English; see menu "De Kunstmaan", "Archief".

I hope these translations will help you to understand the Dutch articles.

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Content

Photo front page:

Receiving X-band, by Fons Buitelaar and Fred Jansen.

Next time more about this.

The New Years meeting was very cozy with a well-attended cocktail. There were no lectures because otherwise the program would become too full . In front of you is yet another new Kunstmaan where you can get a lot of inspiration for our beautiful hobby.

Weather

We've had our share of storms. There was Ciara [1] with a wind speed of 10 bft and gusts up to 130 km / h. A week later we got Dennis, who did not go into the books as a heavy storm. This natural violence made me secure my satellite dish with an extra rope, you never know. It is now waiting for better weather so we not only to clouds look o p our satellite images.

Corona

You cannot escape not to say anything about the Corona virus at this time. Right in the Coronavirus era there must be a satellite image.
NASA and ESA have d e satellites air pollution measured and observed a large decrease of C O2 in China. This is among other things attributable to the Chinese New Year, which many Chinese take a couple of weeks , g proposition due d by the shutdown of the society in an attempt to curb the Coronavirus.
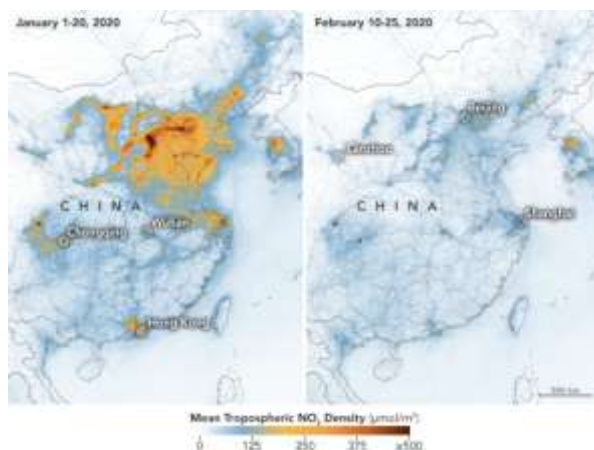
The picture shows the nitrogen dioxide pollution. The recordings are
from ESA's Sentinel-5 and NASA's Aura satellite.

How will the Coronavirus affect our hobby even further? Many electronics parts come from China. For example, I have prints made in Shenzhen (north of Hong Kong). Many airlines have cancelled their flights to China. A lot of cargo goes to Europe in the belly of passenger aircraft. So there is a high risk of delays.

China is also a major supplier of basic raw materials and semi-finished products. If you as a manufacturer just need that one part from China, you cannot finish your product.

Software

There are new versions of software again. For example, KiCad has released ad version 5.1.5. Version 6 will take a while. This year's KiCad conference will be held in CERN / Switzerland. CERN's e e n big sponsor of the open source KIC ad.
And Scilab has released a new version: 6.1.0

Kicad Conference at CERN

The Kunstmaan

Fred shares his experiences from Vietnam again. Paul has a contribution from the library and summary of the VHF SMSs n made.
In this Kunstmaan several articles by Rob. Sometimes locking the 73 MHz oscillator in the QPSK receiver is not always successful . One cause can be temperature changes. The lock behavior can be improved with a few minor adjustments . Furthermore, an article about increasing the PWM frequency of the Arduino . The noise produced by DC motors can thus be removed from the audible range. As secretary and treasurer, he also wrote the financial report and the report of the meetings.
The 2019 annual report was written by the chairman. Just like a story about using Scilab for the orbit calculation of satellites. The NanoVNA did he got to talking and are put findings on paper. Furthermore, a double 5V power supply that can be useful for experiments.
Happy reading!

A replica of the Metop at Eumetsat headquarters

Visit Eumetsat

On July 2 and 3 we visit Eumetsat! The program is partly known. The behind the scenes tour is highly recommended.

The presentations for July 2 will look like this:

- Overview of Current Satellite Operations
- Overview of the MTG Mission
- Overview of the EPS-SG Mission
- User Preparation for MTG and EPS-SG
- Data Access Evolution - EUMETCast
- Data Access Evolution - New Data Services
- Data Reception Systems (by the Werkgroep Kunstmanen / GEO)
- Update on User Service Activities
- Wrap up
- Tour of EUMETSAT Mission Control Center

On July 3 we will visit ESOC.

Links

[1] Heavy storms
https://www.knmi.nl/nederland-nu/klimatologie/lijst/zwarestorms

[2] Nitrogen
https://earthobservatory.nasa.gov/images/146362/airborne-nitrogen-dioxide-plummets-over-china

Weather satellites in Vietnam (35)   **Fred van den Bosch**

Summary
My experiences with weather satellites etc. in Vietnam.

General
There are always things you shouldn't write about. They come back to you like a boomerang. As I wrote last time [1]: *"the past period has been characterized by many problems. Anything and everything gave up or went wrong. Murphy had brought his entire family here. "* Well, they didn't think it was so successful that they got the blame for everything so they stayed for a while and started to wrap around a bit more wildly.

PC
Last time, I had lost all the workgroup files and my NAS had also given up. The PC has continued to work more or less, although I do occasionally get the infamous blue screen. I am afraid that more hardware is about to collapse.

To be on the safe side, I bought a new Acer laptop in the Netherlands during the last holidays. Firstly as a spare for when my big system gives up, secondly because - and now I deliberately stand on long Apple toes - I find the iPad a disaster to work with a bit professionally. It is now being relegated to what it was once purchased for: a color ebook reader. He can barely do that.

NAS
Shortly after being briefly available again, he gave up again. Because the confidence in that thing was completely gone, I took out a subscription to Stack. Uploading everything I want to backup on a daily basis turned out to be a crime ("this folder takes 8 days, 16 hours and 37 min.") But in the end it worked.

Satellite PC
"Finally, some good news. Last holidays I bought an HP 260-G3 desktop mini PC in the Netherlands and have been using it 24/7 in my often (un) reasonably warm hobby room since the beginning of January. To date (and tapping this on uncultivated wood), he remains excellent. " [1] I shouldn't have written that at all.

As has been noted before, the electricity often drops here. The satellite PC is set up so that when the electricity comes back, it starts automatically, including the most important programs. [2] Unfortunately, at the beginning of January he refused all service after a power failure. Days spent on all kinds of recovery programs. Nothing. Wait a week and collect a new energy. Nothing. I repeated that a number of times (more and more reluctantly and shorter) until somewhere in mid-February he suddenly did it again. Welcome to the wonderful world of electronics. Then I spent a long time adjusting everything a bit as it was in the old situation. It is finally starting to look a bit like it again.

GODIL, HRPT and QPSK
The next misery. OK, partly my own stupid fault. In NL, Ben pinned my Godil on a new print, complete with VCO-X. [3] Thank you again for this. Mounted and tested at home in the cabinet. Nothing, not even reception. As far as possible, checked all cables to see if they had been gnawed by the rats. Looks like not. Part of it is in pipes that I have closed as well as possible, but I have noticed that these animals only need a tiny hole. All plugs in the route cleaned. Nothing. A few days ago all cables checked again and suddenly the receiver worked !? I still don't know why. OK, we'll look for it later.

The decoder was still not working. When disassembling I made a sketch with all connections. And neatly connected again. When I looked at the diagram [3] I saw a (separate?) connector

on it (K100) Looked in the box again and yes, well hidden under the connector of the display I saw the input connector. Ropes changed and working. Pfffttt. Admittedly: much better than the old version.

Let's hope that in the next issue I will be able to tell cheery stories about a smooth and automated reception system, undisturbed household equipment and karaoke anti-socials with severe tinnitus.

References, see website
[1] Weather satellites in Vietnam, De Kunstmaan, December 2019, p. 6
[2] Weather satellites in Vietnam, De Kunstmaan, June 2019, p. 4
[3] FT232H, De Kunstmaan, September 2019, p. 6

The NanoVNA

Summary
The NanoVNA is a small affordable vector network analyzer with a range up to 1.5GHz . This article de scribes my experience getting started with this analyzer .

What is the NanoVNA
The NanoVNA [1] is a small portable Vector Network Analyzer , designed by e and Japanese amateur , known under the pseudonym edy555. Initially released as a kit, but now offered as a ready-made module by diligent Chinese . The original design went from 50 kHz to 300 MHz. Chinese amateur Gen Hu known as Hugen, to the design of edy555 forth ge embroidery d and came up with a version that goes up to 900 MHz. New versions go up to 1.5 GHz.

The NanoVNA is only 85 x 55 mm in size and consists of a printed circuit board with the components and a second printed circuit board that serves as the back.

With the NanoVNA you can measure inductance, complex impedance of antennas and amplification / attenuation. You can also adjust filters and measure coax cables . For antennas, the NanoVNA is very handy because it can be hung directly on the antenna power point.
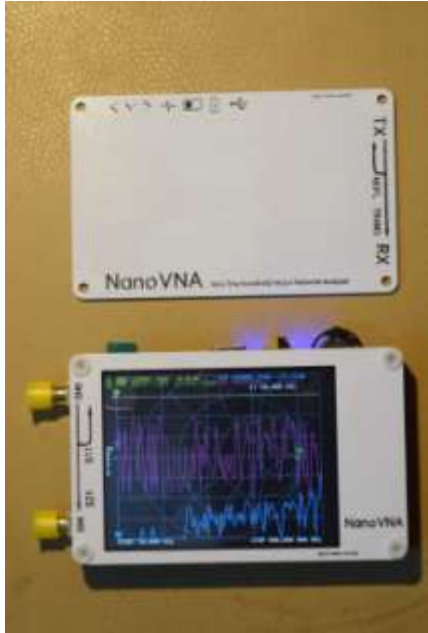

Fig 1 Front and back of the NanoVNA

Compared to other measuring equipment, the Nano VNA allows you to :
- measuring amplitude AND phase of a signal
- measure with two ports : the reflected signal (S11) at the input and the signal at the output (S21).
The NanoVNA has 101 data points equally divide d over the measuring
range. Therefore it is important that the frequency aa giving one where the main focus of interest.

Block diagram
The Si5351A clock generator has three separately programmable
outputs, which by an STM32 microcontroller word and controlled. The signals go to three SA602A -mixers in. The mixed products go to the AIC3204 audio chip that functions as an AD converter . Then the information goes to the STM32 which measures signal strength and phase difference. The result is on the display shown or transferred to the PC.
At frequencies above 300 MHz, the harmonic n of the Si5351A is used.
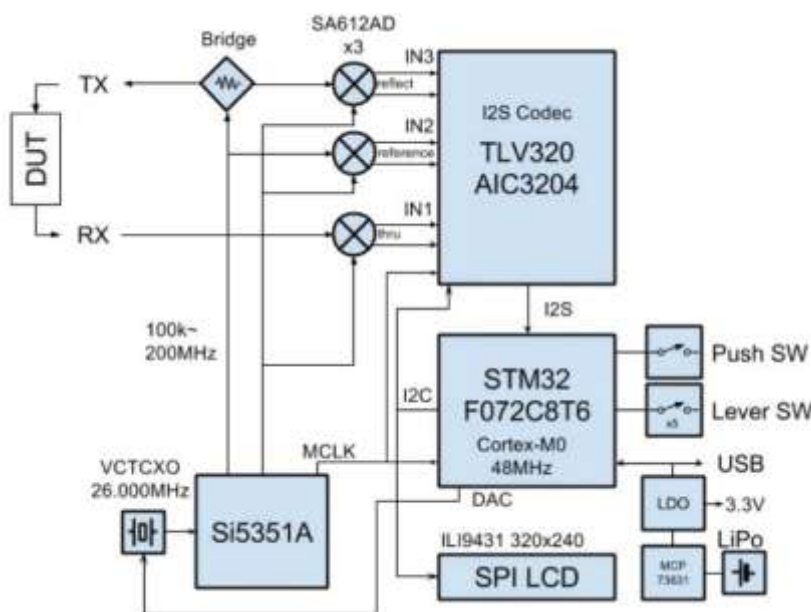

System Block Diagram:
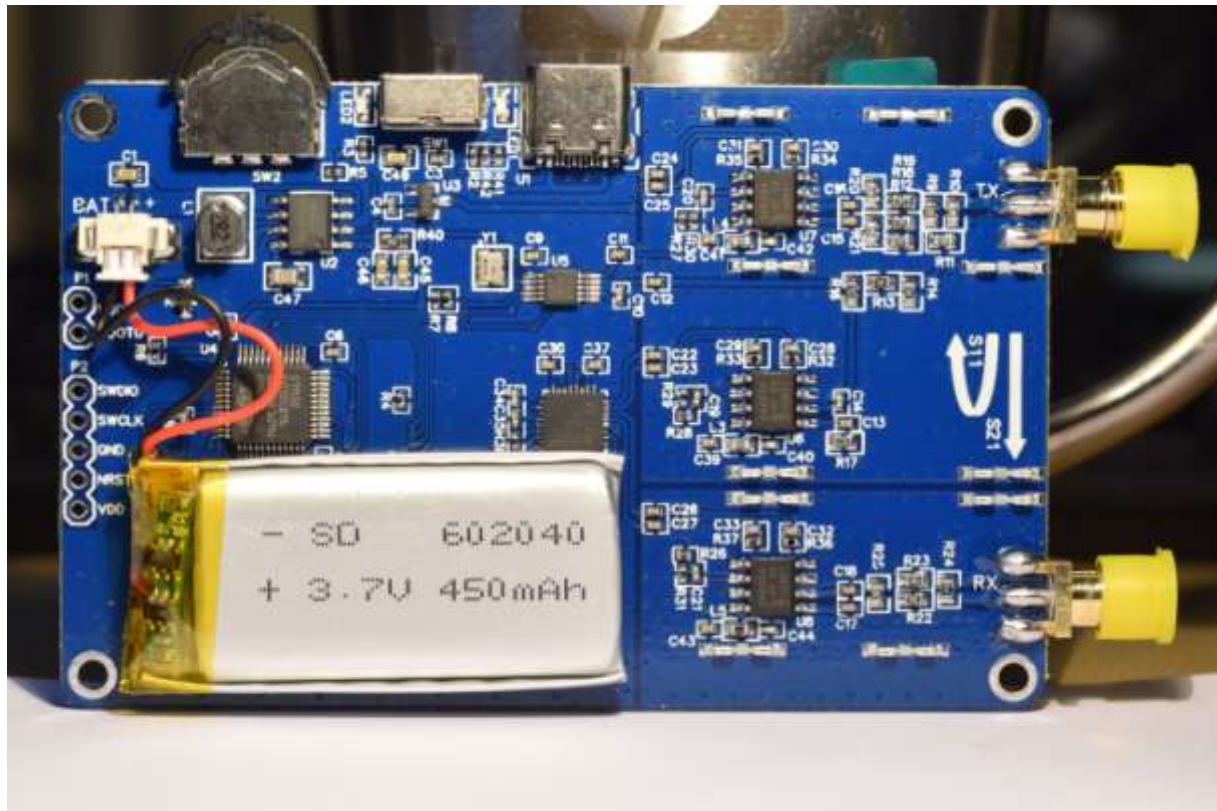
Fig 2 The block diagram

Fig 3 The PCB, with the battery at the bottom left and the three unshielded SA602 mixers on the right.

To order

When you NanoVNA want to appoint one there are some things to look out for:
- has d e NanoVNA a USB connector
- it is equipped with a battery for portable use . See the picture above
- are the mixers shielded
- An SMA SOLT set is included : Short, Open, Load (50 Ohm terminator) and Through

I bought my NanoVNA at Amazon .com in Germany for around 35 Euro.

Additional matters

Often there are no SMA cables (male-male) with the delivery . If these cables are supplied, they can be of questionable quality. Gunthard Kraus [2] therefore recommends quality cables to be used , for example those
of Huber + Suhner . These cables are quite expensive at Mouser . I found 10 cables myself by searching eBay for " Astrolab Minibend ", Astrolab has been taken
over by Huber + Suhner . Fortunately, there was no need to import duties and
VAT. Ten pieces cost 65 Euro. These cables can also be found (not by me) at fairs. Further, you as Gunthard , to obtain reproducible measurements , an SMA torque wrench (SMA torque wrench should have). Available with SDR kits or Mouser (455-74Z0079) for more than 140 Euro.

Fig 4 SMA torque wrench

Modifications
In some models, the mixers (the well-known SA602) are not shielded. You can do it yourself, but it is more convenient for a model to buy where the shield has already been made.
The NanoVNA consists of two printed circuit boards. A housing is recommended. You may also wonder if the connectors are of good quality. Affordable Johnson connectors are available at Mouser (530-142-0701-801) for around 4 Euro. The replacement is not easy because of the double-sided print.

Or all of these modifications and expensive cables do any good , I can not say. The necessity of shielding , opinions are divided. Before you know it, the accessories cost a multiple of the NanoVNA.

Firmware
Different versions [3] of firmware are in circulation. If you are new to using the NanoVNA, do not update the firmware. You are at risk and before you know your NanoVNA is unusable.

Calibration
Before you can take accurate measurements , the NanoVNA must be calibrated. K alibration is particularly important for the phase measurements.
You use a SOLT set for this. Because the signals propagate (almost) at the speed of light, we are dealing with a reference plane on which we will calibrate with the SOLT set . With this we compensate everything between the reference plane and the NanoVNA.
Every time you change the measuring range , you need to recalibrate. You can save these measurements .

Fig 5 SOLT . From left to right: Short, Open, Load and Through

Use

You switch on the NanoVNA with a slide switch. In addition, there is a multi -
switch with which you can navigate through the menus. You can also operate the
touch screen with a pen. It is very useful to download a description of the menu
structure [4].
Allow the NanoVNA to warm up for half an hour before you calibrate and take
accurate measurements.
The LCD screen displays up to four traces at a time. You can also work with markers
on your signal.
Many manuals are available on the Internet [5].

NanoVNA saver

The NanoVNA can be used independently , but software on the PC makes use and
operation a little easier. The NanoVNA-saver [6] program runs on Windows, Linux
and Mac. Connection to the NanoVNA is made via the serial port.
With NanoVNA saver , the measuring range can be divided into several
segments. Each segment has 101 measuring points. The software adds the
ve r peel lumbar segments together. Furthermore you can calibrate from the
software.

Example

Fig 6 A measurement of a 300 MHz lowpass filter from Mini-Circuits: BLP-300 +

Concluding remarks

For little money you buy a VNA that would have cost (tens) thousands of Euros years ago. It is an educational device and you do not bump with the purchase .

Currently , the NanoVNA version 2 is being designed which should go up to 3 GHz.

Left

[1] NanoVNA
http://nanovna.com/
https://github.com/hugen79/NanoVNA-H
https://groups.io/g/nanovna-users/

[2] Gunthard Kraus manual
http://www.gunthard-kraus.de/fertig_NanoVNA/English_NanoVNA%20V1.5._final.pdf

[3] Firmware
https://github.com/hugen79/NanoVNA-H/releases
https://github.com/ylabrj/NanoVNA_Load_Windows10

[4] Menu structure
https://groups.io/g/nanovna-users/attachment/547/0/nanoVNA%20Menu%20Structure.pdf

[5] Various Manuals / Information
https://hexandflex.com/2019/08/31/getting-started-with-the-nanovna-part-1/
https://hexandflex.com/2019/09/08/getting-started-with-the-nanovna-part-2/
https://hexandflex.com/2019/09/15/getting-started-with-the-nanovna-part-3-pc-software/
https://www.rfseminar.nl/nanovna/

[6] NanoVNA saver
https://github.com/mihtjel/nanovna-saver/releases/download/v0.2.2/nanovna-saver-v0.2.2-1.exe
https://github.com/mihtjel/nanovna-saver/releases
https://zs1sci.com/blog/nanovnasaver/

Satellite orbit calculation with Scilab

Summary

In this article a small Scilab-script that comes with the CelestLab toolbox has been evaluated. The results are compared to WXtrack and Xtrack .

preface

Scilab has a so-called CelestLab toolbox with which you can do orbit calculations for satellites . It was developed by the CNES, the French space research agency.

I have tried to make as simple an example of a job calculation as possible. Only the time of rise and fall of the sate e t is calculated, d it has been difficult Sat.

Installation

You must install this toolbox separately. Go to the " Applications / Module Manager - Atoms " menu . You will then receive an overview of all available modules.

Fig 1 Installed modules in Scilab

Click on "All modules". Select CelestLab and CelestLab X and press I nstall .

After installation, you will be in the CelestLab menu . Below are several demo scripts .

Orbit calculation for NOAA 19

As a starting point I " Two-line elements / Predic tion or visible taken passes" and made this as short as possible. The input screen and several error checks have been removed.
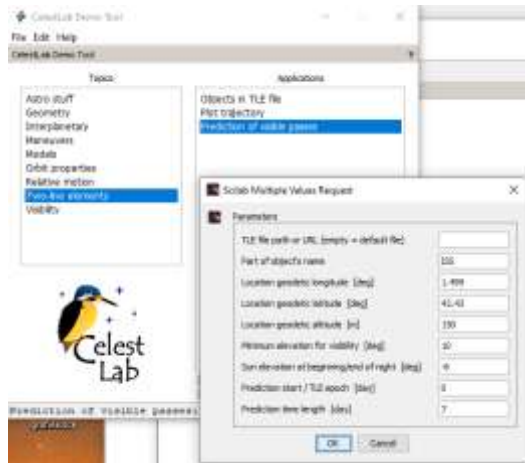
Fig 2 The original script in Scilab with an input screen.

See the end of the article for the script.

The first line contains the function call CL_ init () . Displays a number of variables from the CelestLab - toolbox loaded. See eg lines 10 and 11 where the location of the receiving station is converted from degrees to radians.

Line 4 stores the location of the wheater.txt file, with the Kepler data, in the variable fname . So you must have downloaded the file already.

Line 7 contains the literal satellite name as stated in the weather.txt file.

Data structures

Scilab has so-called data structures , with field names to which values are linked. With the command ' struct ' you create such a data structure, eg :

```
-> MeetingWorkgroup Kunstmanen = struct ('day', 14, 'month', 3, 'year',
2020)
Meeting of Artificial Workers   =

   day: 14
   month: 3
   year: 2020
```

You can request a data for the day as follows:

```
-> Meeting of Kunstmanen.dag
ans   =

   14.
```

These are satellites for the orbit calculation . In the re gels 22 through 27 is the data trick t h " tle " loaded with the data from the NOAA 19.

If you type " tle " in the console after running the script, you will receive the following information:

```
-> tle
tle   =

TLE struct contains 1 element: T
-> satnum = 33591
-> classif = "U"
-> intldesg = "09005A"
-> ephtype = 0
-> elnum = 999
-> epoch_cjd = 25628.55228143 (2020/03/02 13: 15: 17.116)
-> revnum = 57004
-> ecc = 0.0014275
-> inc ( rad ) = 1.7312968048083
-> argp ( rad ) = 0.34097450398662
-> raan (rad) = 1.13649732237489
-> ma (rad) = 5.94520404286014
-> n (rad / s) = 0.00102712427875942
-> ndot ( rad / s ^ 2) = 2.33802894053596e-20
-> nddot ( rad / s ^ 3) = 0
-> bstar (Earth radii ^ -1) = 2.6108e-05
-> desc = "NOAA 19"
-> status = 0
```

Actually, the weather .txt file is converted into bite-sized chunks .

I have to explain the term epoch _ cjd . The values shown above in the tle-struct are only valid at one time, this is the time indicated in epoch . This is because the runway data changes due to air resistance, attraction of other objects etc.

I think the " cjd " stands for " converted julian date". The number of days since January 1, 1950 is calculated here.

In lines 30 to 32 , the vector " cjd " of satellite transit times is created . cjd0 is the start day and cjdf is the end day. The vector " cjd " has 1 minute increments calculated as part of a day .

In line 35, the function CL_ tle _ genEphem returns the positions of the satellite in the 3xN array . The ECF parameter stands for Earth Center Fixed .

Line 41 represents the rise and fall at timings of the passes that are visible. You give this function a vector with times that you want to know the matches of, the position at these times, the location and the minimum elevation. You will then receive the returns:

```
-> passes
passes =

    25628.22 25628.29 25628.631 25628.7 25628.774
    25628.227 25628.297 25628.638 25628.708 25628.776
```

We are almost there. What remains is to display this data in a legible format. This is done from line 50.

On line 63, the Julian date / time is converted to legible text t. On line 66, the direction function is called (lines 44 to 48) which returns the azimuth and elevation.

Between lines 70 and 77 is a loop that passes through the passes and makes the data readable.

On line 79 the result is printed to the screen .

```
-> exec ('F: \ WXsat \ Scilab \ Passlist.sce', -1)
-------------------------------------------------- --------------
Visible passes for object 09005A [NOAA 19]
Date (TREF), El ( deg ), [ Az ( deg )]
-------------------------------------------------- --------------
2020/03/03 05:04:47 10.0 [30.4]
2020/03/03 05:14:53 10.0 [162.1]

2020/03/03 06:45:23 10.0 [6.8]
2020/03/03 06:55:53 10.0 [224.9]

2020/03/03 08:28:25 10.0 [334.4]
2020/03/03 08:31:40 10.0 [299.7]

2020/03/03 14:57:53 10.0 [104.6]
2020/03/03 15:06:17 10.0 [4.2]

2020/03/03 16:36:45 10.0 [167.8]
2020/03/03 16:47:43 10.0 [341.6]

2020/03/03 18:21:00 10.0 [243.4]
2020/03/03 18:26:37 10.0 [305.8]

2020/03/03 22:53:38 10.0 [339.9]
2020/03/03 23:59:07 10.0 [13.2]
```

Is it right?

Let me state first of all that I cannot judge whether the results from Scilab are correct. What I have done is compare the results with WXtrack and Xtrack .

In both programs I have taken the agreements and looked at which times they exceed 10 degrees elevation and which azimuth is associated with it.

In the Excel sheet below you see in the right columns the differences in azimuth and elevation at the same time.

4 Tijdstip	Scilab		Wxtrack		Xtrack		Verschil in azi		Verschil in ele	
5	azi	ele	azi	ele	azi	ele	Wxtrack	Xtrack	Wxtrack	Xtrack
6 05:04:47	30,4	10,0	30,3	10,1	29,9	10,0	-0,1	-0,5	0,1	0,0
7 05:14:53	162,1	10,0	162,0	10,2	163,9	10,1	-0,1	1,8	0,2	0,1
8										
9 06:45:23	6,8	10,0	6,9	10,0	6,3	9,7	0,1	-0,5	0,0	-0,3
10 06:55:53	224,9	10,0	224,9	10,1	226,5	9,4	0,0	1,6	0,1	-0,6
11										
12 08:28:25	334,4	10,0	334,5	10,1	334,2	9,5	0,1	-0,2	0,1	-0,5
13 08:31:40	299,7	10,0	299,9	10,1	300,0	9,3	0,2	0,3	0,1	-0,7
14										
15 14:57:53	104,6	10,0	104,6	10,1	106,1	10,6	0,0	1,5	0,1	0,6
16 15:06:17	4,2	10,0	4,2	10,1	3,7	10,2	0,0	-0,5	0,1	0,2
17										
18 16:36:45	167,8	10,0	167,8	10,1	170,0	10,1	0,0	2,2	0,1	0,1
19 16:47:43	341,6	10,0	341,6	10,2	340,7	10,0	0,0	-0,9	0,2	0,0
20										
21 18:21:00	243,4	10,0	243,3	10,1	244,2	9,3	-0,1	0,8	0,1	-0,7
22 18:26:37	305,8	10,0	305,8	10,1	305,1	9,5	0,0	-0,7	0,1	-0,5

The differences are minimal with Wxtrack and Xtrack .

For completeness, you should also calculate the deviation when the satellite is at its highest point. Furthermore, you cannot specify the height of the receiving station in Xtrack , this will probably make very little difference .

How much can it deviate?

If we take a NOAA 19 through the zenith then only one second will give a deviation of half a degree in elevation (plus the deviation in azimuth), I don't know how to calculate the total deviation.

For the reception of the 8 GHz band , people sometimes express the wish to be able to aim accurately at the 1 / 10th degree. Then zi jn some issues of great importance : what is the correct path calculation, your Kepler data up to date and correct time in your system .For the reception of 1700 MHz are the two programs ' s absolutely accurate enough .

Concluding remarks

The script shown is still simple, but very complex for me. I have all the variables at the command prompt typed to z o find out what happen t . And yet all the difficult calculations in the functions of CelestLab have been stopped. Hats off to those n a nice job calculation with a convenient user interface to make!

And to the future: I suspect that if you want to follow with an accuracy of less than one degree, you may have to follow with a combination of signal strength and track calculation. To be continued!

```
1  CL_init();
2
3  // TLE file name
4  fname = "c:/temp/_ben/weather.txt";
5
6  // name of object
7  objname = "NOAA 19";
8
9  // location (geodetic coordinates)
10 lon = 4.45 * %CL_deg2rad;
11 lat = 51.92 * %CL_deg2rad;
12 alt = 10; // m
13
14 // min elevation from location for visibility
15 elevmin = 10 * %CL_deg2rad;
16
17 // Prediction time span (days) from TLE epoch
18 pred_start = 0;
19 pred_len = 1;
20
21 // Initialize TLE
22 tle = CL_tle_load(fname);
23 I = grep(tle.desc, objname);
24 if (I == []);
25     error("Specified TLE not found");
26 end
27 tle = tle(I(1));
28
29 // Time instants for computation (TREF)
30 cjd0 = floor(tle.epoch_cjd + pred_start); // considered here as TREF
31 cjdf = ceil(cjd0 + pred_len); // considered here as TREF
32 cjd = [(cjd0 : 60 / 86400 : cjdf - 0.1), cjdf];
33
34 // Object position (ECF)
35 [pos_ecf] = CL_tle_genEphem(tle, cjd, "ECF");
36
37 // location in geodetic coordinates (ECF)
38 location = [lon; lat; alt];
39
40 // Geometrical visibility intervals of object from location
41 passes = CL_ev_stationVisibility(cjd, pos_ecf, location, elevmin);
42
43 // computes elevation, azimuth (+ towards east)
44 function [elev, azim] = direction(t)
45     pos_ecf_t = CL_interpLagrange(cjd, pos_ecf, t);
46     [elev, azim] = CL_gm_stationPointing(location, pos_ecf_t, res= ["elev", "azim"]);
47     azim = CL_rMod(-azim, 0, 2*%pi); // => positive towards East
48 endfunction
```

```
49
50  // ----------------------------
51  // Print results
52  // ----------------------------
53
54  str = [ ..
55    "----------------------------------------------------------------"; ..
56    msprintf("Visible passes for object %s [%s]\n", tle.intldesg, stripblanks(tle.desc, %t)); ..
57    "Date (TREF), El (deg),  [Az (deg)]"; ..
58    "----------------------------------------------------------------" ..
59  ];
60  .......
61  t = matrix(passes(:), 1, -1);
62
63  cal_str = CL_dat_cal2str(CL_dat_cjd2cal(t));
64  cal_str = matrix(cal_str, 2, -1);
65
66  [elev, azim] = direction(t);
67  elev = matrix(elev, 2, -1);
68  azim = matrix(azim, 2, -1);
69
70  for k = 1 : size(passes,2);
71  //for k = 1 : 1;
72    for (i = 1:2);
73      str($+1) = msprintf("%s %5.1f [%5.1f]\n", ..
74        part(cal_str(i,k), 1:19), elev(i,k)*%CL_rad2deg, azim(i,k)*%CL_rad2deg);
75    end
76    str($+1) = msprintf("\n", "");
77  end
78
79  mprintf("%s\n", str);
80
```

Locking problems demodulator .

The HRPT / QPSK receiver, as described in various episodes (see [1]) , includes a demodulator that must synchronize to the mid-frequency input signal. Although the MF is the same for all 1700 MHz satellites (36.5 MHz), synchronization does not always work. The main reason is the 73 MHz oscillator in the demodulator (MAX2606) which can drift away because of, for example, temperatures changes.
An important aspect here is the so-called catch range of the PLL in the demodulator. As a block diagram, the PLL part looks like in Fig. 1; a classic PLL, with an active low-pass filter (LPF). For clarity, only the HRPT part has been drawn here. The phase detector gives a balanced signal that goes to the active filter.
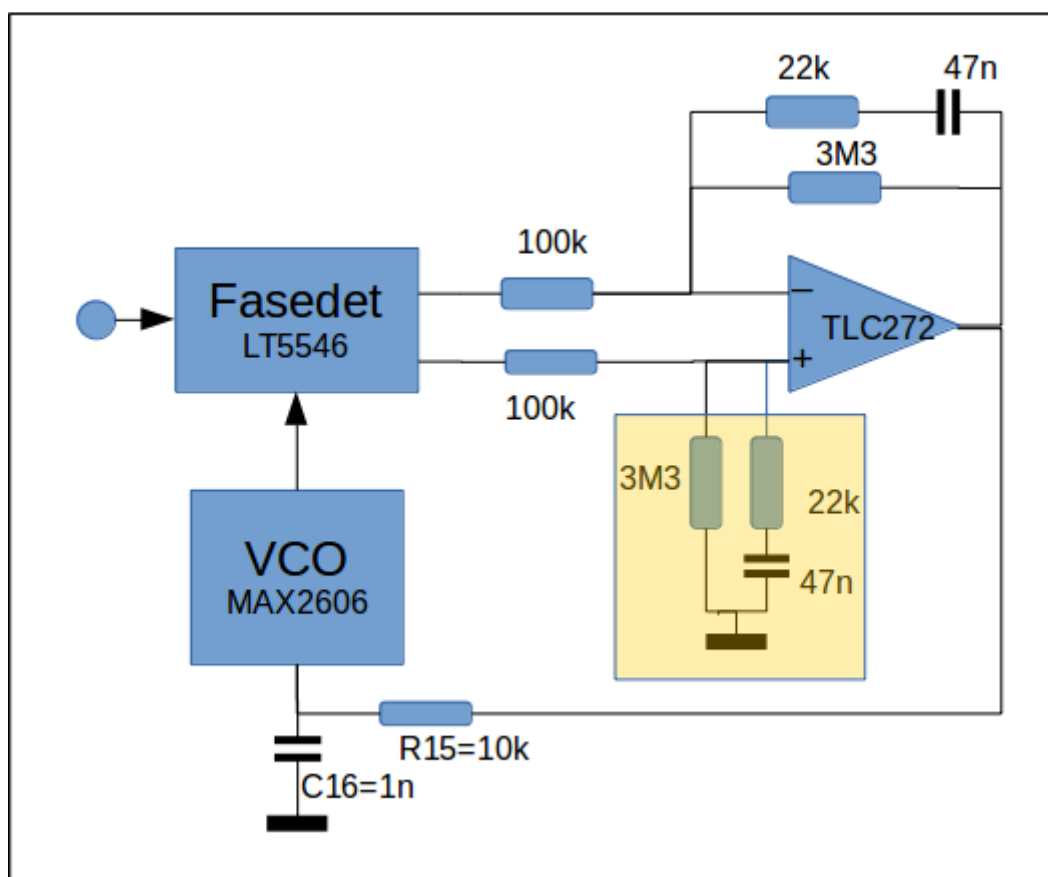

Fig. 1. Block diagram PLL, HRPT part

The yellow boxed part is not included in the original schematic. These components are required for well-balanced processing, otherwise the active filter will work differently for the bottom branch to the + input of the opamp, compared to the top branch, to the - input . Moreover, in-phase signals, which do not contain information and which you therefore want to lose, are not completely suppressed. In practice, the lack of these components does not seem to make much of a difference.

The active filter now controls the input of the VCO, via the RC network R15 / C16 , more about that later. The VCO controls the phase detector again; the loop is closed.

It is important for the filter that not all HF spectrum components are suppressed, otherwise the VCO cannot capture:

If the input and VCO frequency are not equal, the phase detector will output a sum and difference frequency. The sum frequency is not important; the signal part around the difference frequency contains a DC component with which the VCO is adjusted. This is caused by the VCO itself being frequency-modulated again by the control signal. The differential frequency can be, for example, 100 kHz. If this is suppressed by the LPF , the VCO is also not frequency modulated and the driving DC voltage disappears. The PLL can not catch. Hence, in series with the C of 47 nF a resistor is included; so even at a higher difference frequency there is still a signal which is frequency modulating the VCO, causing a DC signal to adjust the VCO. The gain in this case is for low frequencies 3300/100 = 33x and for high frequencies 22/100 = 0.22.

Calculation of the catching behavior is a very complex matter; the behavior appears to be described by a nonlinear differential equation for which no exact analytical solution is known. ([2])

Three frequency ranges can be distinguished:
  - Hold Area: the frequency offset, wherein the PLL just stays synchronised
  - Direct catch area: the frequency deviation at which the PLL locks directly (within 1 period)
  - Creeping catch area: the frequency deviation at which the PLL will eventually lock

```
<---------- | ----------> hold
    <---> | <--->          creeping catch
      <- | ->              immediately catch
```

The direct capture area is the smallest, you would actually like to keep the frequency deviation in that area. With creeping catch, at some time the frequency will come into the direct catch area and then the PLL locks immediately.

One way to be in or as close to the direct capture area as possible is to use a VCXO instead of a VCO. I haven't got that working yet, but with a regular VCO there is also room for improvement.

Measuring the capture area is easy to do with a generator. The receiver without a down converter receives around 150 MHz. By setting the tuner to that frequency and then increasing the frequency of the generator from 150 MHz, the PLL will become out of sync at a given frequency. Then we sit on the edge of the holding area.

Then we decrease the frequency until the PLL locks again; that is the limit of creeping catching. The same can be done with lower input frequencies, by just regulating the generator to lower frequencies.

In this measurement, the holding areaappears to give no problems (more than enough space), but the creeping capture area appears only approx 50 kHz. Adapting the LPF gave no other result.

The culprit turned out to be the circuit R15 / C16 at the VCO. This is also a low-pass filter, but it should not participate as such. C16 is in series with a varicap in the VCO, R15 is necessary to prevent the opamp of the LPF directly driving that C16. This parasitic LPF has a crossover frequency of approx. 16 kHz, which makes the capture area too small. The C is already at the minimum value required for the VCO. Decreasing R15 to 1k gives a 160 kHz crossover frequency, which increases the capture area by approx. +/- 185 kHz , almost a factor of 4.
The following table shows the measured holding and catching ranges.

	lock PLL	R15=10k	R15=1k
	kantelfreq. met 1 nF	16 kHz	160 kHz
1	goes off-lock low	149,70 MHz	149,70 MHz
2	goes in-lock low	149,95 MHz	149,87 MHz
3	goes in-lock high	150,05 MHz	150,24 MHz
4	gaat uit-lock high	151,70 MHz	152,02 MHz
	hold range (4 - 1)	2000 kHz	2320 kHz
	capture range (3 - 2)	+/- 50 kHz	+/- 185 kHz

This will also help for the QPSK mode, but there is another point here. The QPSK demodulator is a bit of a strange case, which also involves switching (see [3]). In the 74HC4053, which is used for this, the switching voltage will leak a little to the outputs of that IC, which also depends on the data rate. This makes it difficult to adjust the demodulator for QPSK in such a way that all Fengyuns and METOPs are "caught" without any tricks. Removing (shorting) R31 ... R34 reduces the "leakage" of the switching voltage, so that capturing all satellites is problem-free. ([4])

In order to arrange the matter optimally, Harrie v. Deursen (the designer of the demodulator) proposes the following:
- Replace R15 with 1k
- Short circuit (remove) R31, R32, R33 and R34 (330 ohms)
- In HRPT mode, adjust the VCO to noise (so no reception) to 73 MHz (e.g. with a frequency counter and a pickup coil)
- In QPSK mode RV2 adjust to 3.9V VCO voltage (this can be read on the display) . Also on noise, so without receiving a satellite.

The aforementioned adjustments have resulted in a wider catchment area at Harrie. Previously, the demodulator did not lock on all satellites, and for example Fengyun-3a and b had to be locked by a bit turning of a potentiometer or switch to HRPT and back to QPSK mode in order to lock the PLL. Now that is no longer necessary and the demodulator, once properly adjusted according to the above rules, always locks. I have not been able to test this myself.

Capturing these types of analog PLLs can also be improved by modulating the control voltage of the VCO with a sawtooth when off-lock, so that the frequency of the VCO is "dragged" through the hold region. The PLL then locks, and the sawtooth must be stopped. This does require a reliable lock indication. It makes the whole more complex as a result.

References: (see website wwwkunstmanen.net, menu 'Weblinks')
[1] Overview articles about the QPSK receiver and decoder:

[2] Phase lock loop. Postgraduate course, electrical engineering department Delft, 17-1-1980
Alternative: " An optical receiver, a phase lock loop and a channel selection circuit for a digital audio distribution system via fiber optic ". Chapter 3.2, page 30 etc.

[3] Demodulating QPSK: KM2013 No. 1, p. 22 and KM2013 No. 2, p. 58

[4] Diagram modulator: KM2016 No. 4, page 14

Pulse width modulation with Arduino.

One of the many possibilities of an Arduino is to generate a square wave with a variable duty cycle. One application is to control the speed of a DC motor, for example in a rotor system. Here, it is necessary for the disc to rotate fast until close to the desired position, and then the last piece at a low speed. This is to prevent the rotor from "slipping".
The ATmega processor used in, eg., the Arduino Uno has six pins to which a square-wave voltage with a variable duty cycle may be made, varying from 0 to 100%. A 50% duty cycle will provide a symmetrical block voltage, which will run the motor at half speed.

According to information given by Arduino the frequency of this square wave is fixed (see [1]). For an Arduino uno with Atmega328:
   • pins PD3, PB1, PB2, PB3: 490 Hz
   • pins PD5, PD6: 980 Hz
These are rather low frequencies that, depending on the type of motor used, can give a quite annoying noise.
Fortunately, there is something to do, because the frequency can be adjusted in the processor. The reason this is not propagated by Arduino is possible because then timers have to be set differently which can influence other things, such as delay functions. In other words, a differently set frequency of a PWM output can interfere with the proper functioning of other functions.
In fact there is just one timer which you should stay away from: TIMER0 that besides delays etc. also determines the PWM frequency of PD5 and PD6 pins. So these should not be used. An overview, for the Arduino's Uno / Nano / Mini: (see [1] and pins_arduino.h)

Arduino Pin	Atmega 28 PDIP	port	Timer	Freq.	To adjust
3	5	PD3	2B	490 Hz	yes , up to 2 MHz
5	11	PD5	0B	980 Hz	Better not
6	12	PD6	0A	980 Hz	Better not
9	15	PB1	1A	490 Hz	yes , up to 2 MHz
10	16	PB2	1B	490 Hz	yes , up to 2 MHz
11	17	PB3	2A	490 Hz	yes , up to 2 MHz

It should be noted that the pulse width resolution decreases at higher frequencies. At 2 MHz, this is only 2 bits, so 4 different dutucycles.

Adjusting the frequency is very easy, but a special library must be installed: PWM.h. To add in the code:
   • #include PWM.h
A number of new functions are now available:
   • InitTimersSafe () and InitTimers ()
   • SetPinFrequencySafe (p, f) and SetPinFrequency (p, f)

The functions and their 'Safe' equivalent are almost identical, only the 'Safe' functions keep TIMER0 undisturbed. Because enough pins remain to use as a PWM (4 pieces) best is to use only the "SAFE" functions. In the 'setup ()' part you should then add:

```
InitTimersSafe ();
SetPinFrequencySafe ( pinnr , freq );
pinMode ( pinnr , OUTPUT);
```

With filling in for 'pinnt' the number of the pin on which PWM is to be applied.
For example, make PB1 and PB2 (pin 9 and 10, respectively) a PWM pin at 10 kHz:

```
#define PWMFreq 10000
InitTimersSafe ();
SetPinFrequencySafe ( 9 , PWMFreq );
pinMode ( 9 , OUTPUT);
SetPinFrequencySafe (10, PWMFreq);
pinMode (10, OUTPUT);
```

After this, the pins can be provided with the desired duty cycle, for example:

```
pwmWrite (9,128); // 50% duty cycle
pwmWrite (10,255) // 100% duty cycle, so continuously 'high'
```

The PWM value must therefore be between 0 (0%) and 255 (100%). With 0 the output is satbel 0V.

More information can be found in [2].

The PWM-l ib rary can be found at [3]: <u>Arduino PWM Frequency Library v_05.zip</u> . The directory PWM must be placed under 'libraries' for the Arduino installation .

References: (for links see website: www.kunstmanen.net, menu 'weblinks').
[1] Arduino reference, analogWrite()
[2] Arduino forum: PWM frequency library
[3] arduino-pwm-frequency-library

UKW-BERICHTE

Paul Baak

Summary
In this article a concise review of articles published in the 4th edition of
2019 of the German magazine UKW-Berichte [1]. We have a subscription
to this magazine.

Here is an overview of UKW-berichte 2019 Heft 4. This was issued at the
beginning of this year, so the backlog in publications has largely been made
up for. We find 5 articles, plus the usual overview with internet links. Our
club has a subscription to this magazine. Please indicate whether you
appreciate this subscription! Positive or negative, it doesn't matter, as long
as your board hears something. The latest editions are available for viewing
at meetings on the library table.

Ralph Berres describes a 2-way measuring head with a wide dynamic range

of 80 dB. The wobbler of Rohde and Schwarz type SWOB5 has a measuring head with a range of 65 dB, which was not enough for the author. He uses two modules of the greek radio amateur SV1AFN with an ADL5513. This IC itself has a range up to 4 GHz. He creates a design with LT spice and builds it with a range from -70 dBm to +23 dBm but keeps non-linearities below -55 dBm. The entire (Eagle) schamatic diagram is in this sheet and is somewhat difficult to read.

Gunthard Kraus builds a receiver for 5.8 GHz with an output at 1.7 GHz. That signal is then processed via an SDR dongle on the PC. The frequency stabilization is taken from a GPS module. The output frequency is no coincidence: in the future it is intended to receive the data stream from Meteosat. The choice for the 5.8 GHz is not further explained, but one may have WLAN in mind. There are a few more recommendations for construction: tighten all SMA connections with the prescribed torque; seal all metal covers with conductive silver and use ferrite beads on all power lines.

Wolfgang Schneider describes a converter from 10 to 25 MHz. It is goal is using the very accurate (0.1 ppb) generators that are available for 10 MHz. The signal frequency is divided by two and the fifth harmonic is used with 25 MHz crystals. That frequency will then become available with the same high accuracy for some LNBs and tunable signal generators as the AD4351 or other systems that use 10 MHz.

Jochen Jirmann continues with the third article about his active antenna connected to a Reuter RDR 51 receiver that was discussed in the previous article. He describes his experiences on the shortwave and mentions the interference up to 5 MHz by his solar cells on the roof.

Vector Network Analyzers may enjoy great interest these days. The low cost and the great possibilities obviously contribute to this. In this magazine an editorial with a short review of the free manual (tutorial) [2] that Gunthard Kraus wrote about the NanoVNA. Quick tips: one offer on Ebay is not the other; so make sure that all accessories are included. Use additional software to avoid the small screen and observe the result on a larger PC screen. The tutorial can be downloaded from Kraus' site and the screen software listed is NanoVNA saver by Rune Bromberg [3].

In Fundstelle Internet we often find inspiring internet links. Here I mention links about antennas and their design such as the circular spiral antenna (something for us?) on Hexandflex [4], and links for manuals of old measuring instruments from HP-Agilent [5].
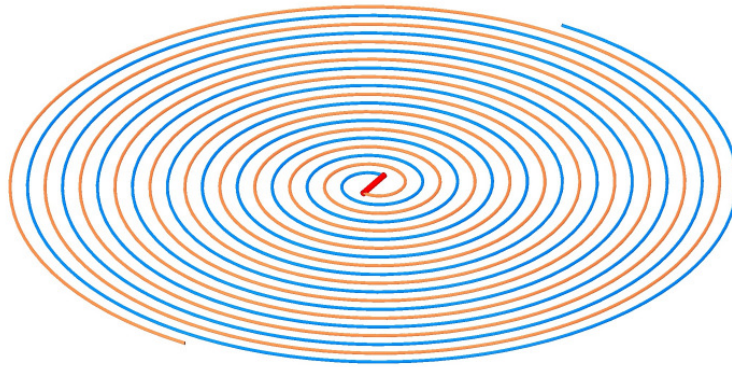
Under the heading ULTRAKURZ a mention of a new book by Elektor, by author Günther Spanner: "Robotik und künstliche Intelligenz" [6]. It relies on Arduinos and Raspberries and contains examples of mechanics and electronics. On the front picture there is a sturdy robot arm that reminds me of a possible armature for an antenna dish; thats why I refer to it here.
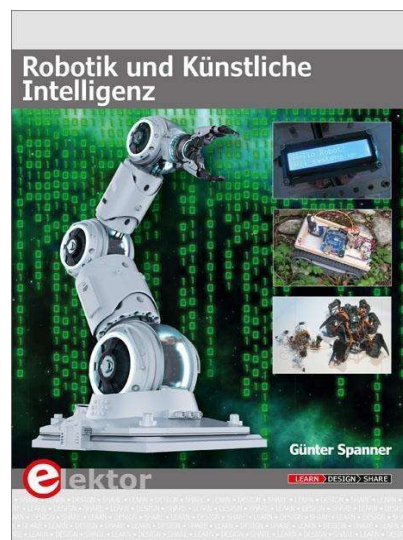
UKW-Berichte is a German language edition, now without an English version that previously existed under the name VHF communications. Including shipping from Germany, the magazine costs 33.20 Euro per year as of the year 2020.

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links to be found on kunstmanen.net:
[1] UKW-berichte
[2] tutorial NanoVNA by Kraus
[3] NanoVNA-saver
[4] Spiral antenna
[5] HP Agilent Schematics, Service Manuals
[6] Book Robotik, G.Spanner

From the Library

Dear people,

These are chilly days, despite the cautiously approaching spring. It is good that we have a hobby that keeps us busy. It can be difficult to keep the club and especially the meetings running in the near future. Fortunately, we have modern media. From my keyboard I make the following contribution.

The book has been issued for over a year ago, but interesting enough to mention: Electronics for Space [1]. We don't really think about this from earth below, but it is a separate branch of sport to have and keep electronics in space reliable. Bottlenecks such as temperature, vibration or radiation are obvious. But did you know that vapors from plastic are a problem? Or hair traces from tin? If you want to put an amateur satellite in space yourself again or are just interested, this book is a good start. NASA also has a nice presentation available for a first impression: Space Electronics A challenging world for designers [2].

I passed the radio exam from the Telecom Agency (dutch FCC). Thank you, thank you! It is even the second time. I also did this about fifteen years ago. Then came a period with many hospitals and because I thought I would never get to using it, I discarded the letter of passing. Now it starts itching again because I had visions and dreams of standing in the garden with a yagi and pointing at ISS. I made four mistakes though, all of them actually because of not reading the question correctly. In this way one learns something about oneself. I also have comments about the Agency. Some questions relate to legislation that no longer exists, and also a bare diode graph asking: Is this a regular or a Zener diode is also not useful. I once learned in Delft University that the solution to a question can be quite difficult, but the question itself should not call into question. I understand that the amateur associations are already discussing with the Telecom Agency, so I will let it go.

Virtual Network Analyzers are widely popular these days. See also elsewhere in this issue. The VERON Zoetermeer department publishes a monthly (PDF) magazine called Razzie. Free and very readable and

educational. In the March issue [3] an article about the NanoVNA in practice of Bart Weerstand. A positive opinion about the 34 euros spent, the hint to order the measuring bridge with it and a positive opinion about the accuracy. It does not say how high in frequency his NanoVNA gets - I now have the idea that one VNA is not equal to the other.

Elsewhere in this magazine I mention the book Robotik by Gunther Spanner. On the front plate of it, a sturdy robot arm that reminds me of something I thought of long ago. We sometimes have a discussion about what is most suitable now: an XY or an azimuth-elevation setup. Without speaking from experience, I imagine that the advantage of one is the disadvantage of the other and vice versa. I don't see a clear winner. Would it be possible to combine both systems with 3 motors? It will cost a bit, but maybe it can be done with a very strong robot arm. An idea for the upcoming rotor discussions? Just call!

Attended last week at Dirksen Training: an afternoon seminar for anyone who is involved with a technical approach to the upcoming energy transition. We would be told about the expertise and skills we need to do that. It was not a cheering afternoon; it remained somehow superficial and fragmentary for me. My thoughts went to our club, where we manage to combine all the expertise with sometimes lively discussion but also in unity.

It has been the practice for years that an email address must be given immediately to obtain some information on a website. I started that 30 years ago with the FlightSimulator from Micro$oft. Of course I never saw the promised updates, but the most irrelevant advertising. This is also the case with Philips (once a stronghold of applied science) and now I am thrown to death every week with an Airfryer. I doubt they can deliver those things these days. If they can do that, they should immediately put on mouth masks. Also useless. And so it goes on. I already have dozens of "accounts" but yes, sometimes you can not escape it.

For example, I once submitted my mail address to Texas Instruments and this time I got something more relevant to read. They want to make their circle of resellers more orderly and therefore reduce them. It is important for all of you to know that Mouser and DigiKey will continue in the circle of

resellers [4]. In addition, Texas Instruments suggests that you just buy at ti.com. Make your mind up.

It's all easy for me because I live near Radio Twenthe. For me the favorite hangout for the modern older youngster. They also have more and more current components. In addition, Elmar also has a lot to offer and forms a skilled liaison officer to Reichelt and Pollin.

I am using and following updates of a freeware emulator for the Arduino called UnoArduinoSim [5]. It is still being developed and has now arrived at version 2.7.1. It is useful for the hardware developers among us to know that there is now extensive support from the periphery. The first start screen is full of switches, 7-segments, motors, piezos, LCD, I2C and SPI devices and you can see for yourself. The only drawback I see is the limited assembler support. This will not be a bottleneck for our motor engineering folks.
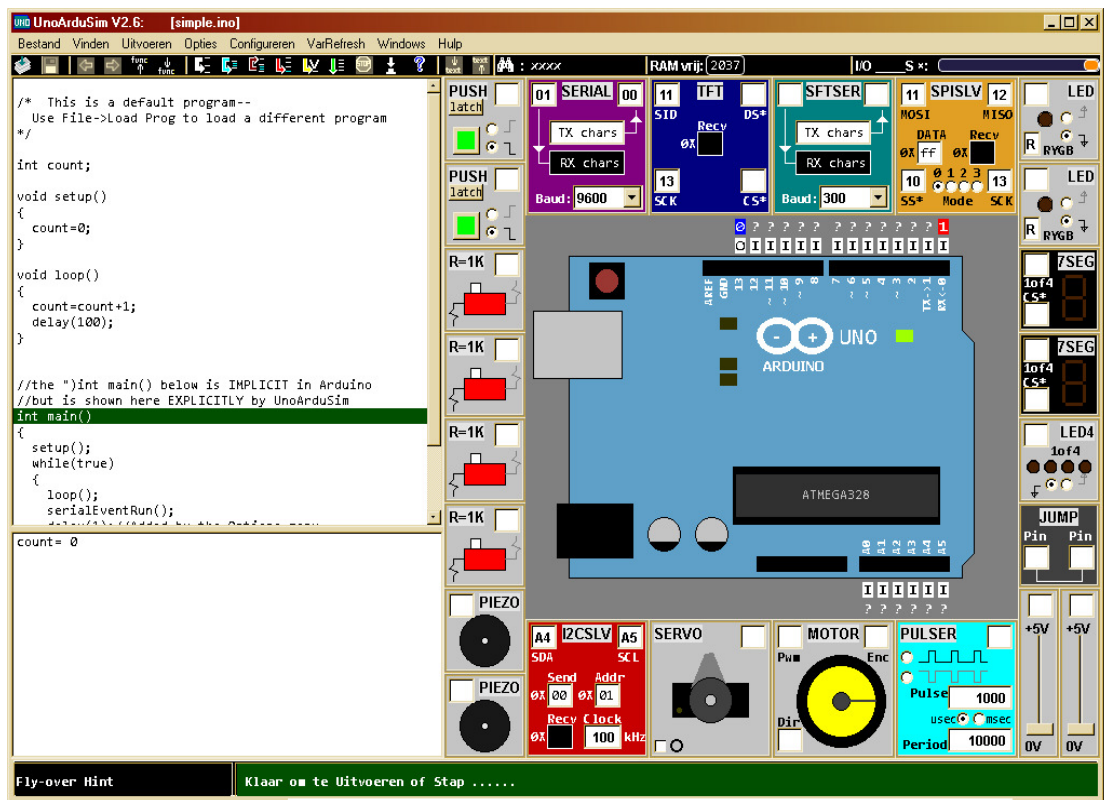
Not a joyful last item this time with a wink of the eye to everyday life. The concerns for all of us are just too great. Last week I was in Utrecht for library work in the extinct Nimeto school and found two deadly bored porters there. Only with my sweetest smile was I allowed to go to our library in the basement. Then you notice that something is going on. I had to refrain from the last meeting. Many members will be in the risk group as well. That you and yours may be saved is the (this time) sincere wish from

your librarian

Links to be found on kunstmanen.net:
[1] Electronics for Space
[2] NASA presentation
[3] Razzie with NanoVNA
[4] Texas Instruments distributors
[5] UnoArduinoSim

Annual report 2019

The meetings
On January 5 there was again the cozy New Year 's drink with 25 members . Fred was again over from Vietnam. With 8 ⁰C above zero it was nice and soft and no problem to get to the Nimeto.
Since it was school holidays , is the Nimeto been opened up for us and the building was heated for us. Parking was additionally abound.
After the general section in which your president d e usual New Year's speech gave, was back at 2018 and look ahead to the development plans for the 7.8 GHz . As far as we know there are two amateurs who can receive this. This is a major challenge for us as a working group . During the survey said Wim him an 8, 4 GHz converter bought and Peter Smits showed a self-built rotor. Then time for the drink , offered by the board .

Attention to Rob's lecture

At 13:00 your chairman gave a presentation about a self-designed down converter . As the VCO / PLL, the ADF4351 is used with a triple cap with pipe caps . The LNA is equipped with FETs from the TV- sat LNBs , Mixer from Mini - Circuits. From the members came valuable suggestions.
Then a short drink, after which Rob gave at 14:15 a presentation about the development of a constellation viewer. He had started a ATmega328 but because of the much better specifications on the ST M switched 32. The pleasant meeting lasted until 15:30.

Harm approves the wine

On March 8 the second meeting of the year. This time Nimeto was packed with other guests and we were looking for a free parking spot. If this does not work, you will lose 2.90 Euro per hour. The turnout was good with 22 people present.
Despite the inclement weather we could the Comparative measurements between the patch - antenna designed by Oleg and helical outer let go of Harry. Your chairman had brought things for sale again. Slowly but surely the bottom is coming into view.
Rob showed his constellation viewer, equivalent to using the oscilloscope. Furthermore, had the President a control board for Agilent attenuator included. Elmar showed his UV exposure box .

The General Members' Meeting was held on 11 May. Rob presented the figures for 2018 and granted job on behalf of the auditing committee approval at the figures. There is a loss of 564 Euro for 2018. As long as the Working Group can bear this loss, the contribution will not be increased.
The Eumetsat trip is canceled and members have been asked whether we should organize it.
During the survey, it appears that several members are busy with reception heads for the 7.8 GHz . Wim showed LNBs with a conical depolarizer . An example of LNBs for the Eshail satellites is to attempt to make a combined LNB: patch antenna for the 1700 GHz and feedhorn for the 7.8 GHz . Fons has made several LNB's out of copper tube, with different depolarizers .
Rob gave a presentation about the NOAA-20 decoder. By dividing the Viterbi decoder in steps, it is no longer a problem to include it for the NOAA-20 in the GODIL. Unfortunately, the recipient is not there yet.

On September 14 was the first meeting place after the summer. With 18 members was what rusti g there. Timo gave a nice lecture on the use of a VNA. He showed the VNA from SDR kits .

This year's last meeting was on November 9. Twenty people were present and Job gave a lecture on noise measurement.

Fairs, excursions
Henry has made four monitors for an advertising where slideshows through play different Raspberry Pi's.

We have designed a spreading brochure for the fairs.

Spreading brochure

Visit Eumetsat
In early March 2019, the Geo decided to cancel the visit to Eumetsat due to the lack of interest. Inquiry at our March meeting indicated that there were ten interested people to go.

Scholarships
Traditionally, we were at the fair in Rosmalen on March 16. Participants were Harm, Ben, Rob, Hendrik, Arne and Timo .

November 2 was the Day for the RadioAmateur in Zwolle. It was a tame fair. We also had no ideal place in the hall .

Our stand on the Air Force Days

Air Force Days
On June 13 and 14, we stood with a stand on the Air Force Days in Volkel . Hendrik managed to achieve live reception from Eumetsat. The interest was great, both radio amateurs who also want to work as parents and their children topography knowledge came ophale n .

The Kunstmaan
A PDF membership has been devised for foreign members . Six members are now using this. Furthermore, the number of members exempt from dues , sharply reduced. All this with a view to cost savings.

Postage costs were discussed during the board meeting on September 14. This was due to an incorrect postage of 3.24 Euro for the Kunstmaan. We have to check Sandd where shipping is only 0,40 Euro.

The day after the September meeting, it became clear that it was no longer possible to have the Kunstmaan printed by the Nimeto. This caught us by surprise and had to look for another party quickly. This we have found that print work Drukland.nl care t .

Due to the acquisition of Sandd d ear PostNL was also Sandd no longer an option. The partijenpost- tiers of PostNL are too high for us. We have sent the Kunstmaan with stamps from Sandd.

The Kunstmaan was published four times in full color in 201 9 . In total , just like 2018, 112 editorial pages have been published.

Fred has contributed a contribution from Vietnam for each Kunstmaan, in which he records the fortunes of receiving weather satellites.

Arne 's Satellite Status was a regular feature. Another permanent part of the Kunstmaan is the report of the meetings recorded by our treasurer / secretary ai Rob Alblas. In addition to the stories "From the library", Paul has written a summary of the articles from VKW reports for each Kunstmaan .

The March and June Satellite by Fred on made. After that, the layout by our new editor job done . On behalf of the Werkgroep, we would like to thank Fred very much for the amount of work he has done.

In the March issue , Rob describes a constellation viewer for the QPSK receiver . The use of an oscilloscope has thus become superfluous to look at the constellation diagram. With an STM32 processor and an OLED display, you get a compact viewer that can be built into the receiver box. Also in this Kunstmaan a comparison between the helical and a patch antenna as the illuminator. There is g a clear winner to be designated, more research is needed. In this edition also the financial overview of 201 8 and two reports of the January and March meetings , all written by Rob. The 2018 annual report was submitted by the chairman .

In the June Kunstmaan Fred describes troubles to as much as possible to automate. The open source program AutoHotkey is an important tool. HRPT and QPSK photos are edited in Lightroom . With program wsat you set the decoder to the correct satellite type and the rotor can be controlled. Now it is also possible to control the QPSK receiver . Rob describes the adjustments that are needed. Also a follow-up to the constellation viewer. Also a description of Mike 's X-band experiments. It uses a TV LNB and a PLL that generates 6300 MHz. Two of my stories: the rebuilding of a helical illuminator and a description of a control print for attenuators of HP / Agilent / Keysight .

In the September issue of Kunstmaan, Rob introduces a new decoder print . A major improvement is the USB interface : The FT232H instead of the FT245. The FT245 is unusable for the new satellites due to the low throughput speed. Harry designed the new print, thanks for this. Your chairman has returned to work with thousands of sharers . An ADF41020 or the ADF4107 can be selected on one print. The divider used is a limitation. The summer is used to build a geodesic antenna diameter of 150cm. In addition, the President has the Scilab program far identified. He describes a script that controls the spectrum analyzer and shows the spectrum on screen.
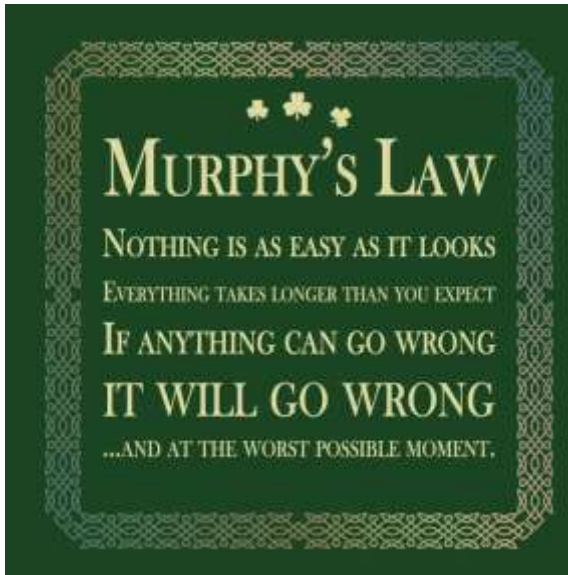
The Murphy family visits Fred

In December Kunstmaan it is the intention to go to Darmstadt in 2020 . And Fred had a visit from the Murphy family . Rob describes new developments in wsat , including zooming in and out, time and coastlines. The chairman went back to work with Scilab and managed to create a picture from the 10B files, which are
stored by wsat . Peter K started working with the patch antenna. He gives a brief introduction to the design aspects of a patch antenna. In this Kunstmaan also a report by Arne of a measuring day that we held on August 16 at a farmer
in O o ltgensplaat . The goal was to measure antennas for the 1700 MHz. The conclusion is that there should be a follow-up with much better preparation. Job writes a short story about noise, he gave a presentation about this.

The Kunstmaan
In addition to the Christmas wish, the Digital Kunstmaan came out six times in 201 9 . As far as can be ascertained, the Digital kunstmaan is well read. The opening rate is around 80 percent, which is very high. The mailing is sent about a week to two weeks before the meeting.
Let everyone who has a nice news for the digital Kunstmaan pass this on to redactie@kunstmanen.net.

Website
There was a meeting of the board to work out the wishes for the new website. The new website is under development.

Satellites

On July 5 is the Meteor-M N2-2 launched a polar satellite which both the 137 MHz broadcast as de1700 t . Unfortunately, the satellite was hit by a micro-meteorite in December that did a lot of damage.

The Elektro-L3 was launched on December 24. This goes to 165 degrees east .
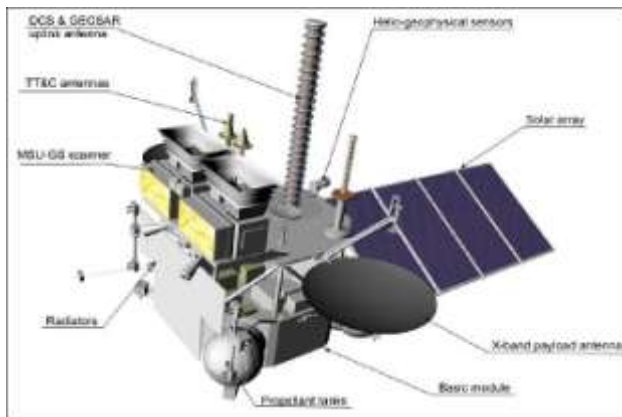
Electro-L3 satellite

Financial annual statement in 2019; 2020 budget

This is an overview of income / expenditure for the calendar year 2019. The actual income / expenditure may have been (partly) made in another year.

The budget for 2020 is also included here. The loss in 2019 has increased again, partly due to higher costs for printing and shipping "De Kunstmaan". Total expenses have been reduced because there are now 9 PDF subscriptions.

The cost item "Nimeto operator" has been removed from 2020, which is why no costs have been included in the budget.

Part of the "Rent Nimeto" costs for 2019 were paid in 2020, hence the item "Nimeto 2019" in the balance sheet.

If there are any questions about this overview, please let me know before the annual meeting (May 2020) so that I can explain this on that day.

Uitgaven	2018	2019	2020		Inkomsten, bezit	2018	2019	2020
	Realisatie	Realisatie	Begroting			Realisatie	Realisatie	Begroting
print+postal costs KM	€ 2.450,00	€ 2.249,86	€ 2.300,00		Contributie	€ 2.765,00	€ 2.625,00	€ 2.570,00
rental Nimeto	€ 319,00	€ 319,00	€ 320,00					
Beheerder Nimeto	€ 400,00	€ 320,00	€ 0,00					
Beurzen inschrijving	€ 126,00	€ 126,00	€ 130,00		Rent Zki savings account	€ 2,32	€ 0,00	€ 0,00
expenses projects	€ 220,26	€ 0,00	€ 50,00		Sell given devices	€ 229,00	€ 45,00	€ 0,00
memberships	€ 84,00	€ 84,00	€ 90,00		Sell KM	€ 0,00	€ 5,00	€ 0,00
Internet fee	€ 57,20	€ 67,20	€ 70,00		Sell components projects	€ 285,00	€ 0,00	€ 0,00
Bank costs	€ 144,93	€ 166,74	€ 170,00					
Paypal costs .	€ 18,24	€ 13,08	€ 15,00					
stamps etc.	€ 21,00	€ 87,21	€ 30,00					
					loss	€ 564,31	€ 758,09	€ 605,00
refund membership	€ 5,00	€ 0,00						
Result expenses	€ 3.845,63	€ 3.433,09	€ 3.175,00		Result income	€ 3.845,63	€ 3.433,09	€ 3.175,00

Balance 31-12-2019

Activa	2018	2019	Passiva	2018	2019
ZKI savings account	€ 7.936,54	€ 6.936,54	Eigen vermogen	€ 7.622,29	€ 6.864,20
Bank	€ 1.108,67	€ 1.225,26	membership next year	€ 1.422,92	€ 1.140,00
			Too much paid membersh 2019		€ 30,00
			Nimeto 2019		€ 127,60
Total	€ 9.045,21	€ 8.161,80	Total	€ 9.045,21	€ 8.161,80

Overview of year-end accounts.

These are the amounts in the various bank accounts at the end of a calendar year.

	2014	2015	2016	2017	2018	2019
Savings account	€ 9.905,62	€ 9.354,50	€ 8.625,60	€ 8.634,22	€ 7.936,54	€ 6.936,54
Pay account	€ 1.628,19	€ 1.409,25	€ 1.045,26	€ 707,38	€ 1.108,67	€ 1.225,26
Cash	€ 1,82	€ 0,00	€ 0,00	€ 0,00	€ 0,00	€ 0,00
Total	€ 11.535,63	€ 10.763,75	€ 9.670,86	€ 9.341,60	€ 9.045,21	€ 8.161,80

Overview of membership and income.

	Realisatie 2017		Realisatie 2018		Realisatie 2019		Begroting 2020	
	aantal	inkomsten	aantal	inkomsten	aantal	inkomsten	aantal	inkomsten
Netherlands	74	€ 1.850,00	77	€ 1.925,00	81	€ 2.025,00	79	€ 1.975,00
Foreign	24	€ 720,00	28	€ 840,00	17	€ 510,00	16	€ 480,00
PDF					9	€ 90,00	9	€ 90,00
Special members	9	€ 0,00	9	€ 0,00	2	€ 0,00	2	€ 0,00
Total	107	€ 2.570,00	114	€ 2.765,00	109	€ 2.625,00	106	€ 2.545,00

The number of "special members" (exempt from membership fees) has drastically decreased; members of the board now also pay. Hence the increase in members of the Netherlands in the table above. The table below shows the member turnover in the past 4 years.

year	exit	new	amount members
2020	-6	1	104
2019	-9	4	109
2018	-2	9	114
2017	-9	11	107
2016	-8	1	105

Rob Alblas

treasurer

Members meeting report January 11, 2020.

Opening by the chairman.

Unfortunately, this meeting coincides with the 'Heelweg Microwave meeting', hopefully that can be arranged differently next time.
The number of members has remained stable over the past year. We are trying to use the Eumetsat excursion to recruit more members.

Our magazine "de Kunstmaan" is now printed by Drukland. Shipping by PostNL is becoming increasingly expensive. We are considering making a PDF edition for the Netherlands as well. Paper is still preferred by many people. However, making and sending our magazine now costs 24 euros per year (for shipping within the Netherlands), then a contribution of 25 euros is very low. For the time being, we will still keep that distribution at 25 euros (domestically).
We have some devices in the Nimeto that are no longer used. Which will be presented at the meeting in march.
As for rotors, there are quite a few systems in circulation. We try to arrive at a standard system. That will be bediscussie at the March meeting. We are still looking at lectures for later meetings; suggestions are welcome, and members are also allowed to present.
Regarding our web site: we had a meeting with a number of people to discuss the setup and the like; that is now being worked on.
The visit to Eumetsat, on July 2 in Darmstadt, will be a highlight. The plan is to keep a story there yourself. By showing the hand, 8 attendees indicate that they are interested in going along.

Next year we hope more developments to see for the 8 GHz. The decoder should already be suitable for NOAA20.

Setting the agenda
An added point: Cash Control Commission, no second person has yet been established. Herman ten Grotenhuis does the check again. Rob Hollander offers to join as a second member. This completes the Cash Control Commission again .

Administrative affairs
Nothing unusual.

Satellite status
Arne gives the current status; see elsewhere in this magazine.

Any other business
Harm: Made a QPSK transmitter; he has a line-up on the table. The GODIL is used as both generator and decoder. The generator generates an I / Q data stream like METOP does; this is offered via an I / Q modulator to a 1700 MHz generator. Via a down converter

and receiver, an I/Q data stream is output from this, which is processed by the decoder. That seems to work well; the decoder recognizes the frame. This could be used as a measuring transmitter.

Harm also made a rotor system, with an Arduino nano. For the elevation a DC motor is used; for Azimut a stepper motor. He wants to give a demo at the next meeting .

Rob Hollander spent a while getting the STM32 to work, with the STM workbench, but that didn't work. With an Arduino he had it done in half an hour. A moment of happiness when finally the "blink" program indeed makes an LED flash; such a moment is experienced by more people when, after much effort, something finally succeeds.

Rob also has a program to calculate the radiation diagram of an antenna; that is written in Matlab and he wonders if it can run in Scilab. According to Ben, that shouldn't be much of a problem if no special IP code is used.

Job de Haas: has bought a few broken VNA's, they are relatively easy to repair.

Fons Buitelaar, Fred Jansen: Are busy with reception on the 8 GHz band. At 25.9 ° east is a geostationary satellite Es'hail 2 / QO-100, which is used by radio amateurs. It has an uplink at 2.4 GHz and a downlink at 10 GHz. The knowledge required to work with this satellite can also be used for the 8 GHz band. Fred shows some homemade feeds, for circularly polarized signals. Building designs can be found on the internet. In the summer he hopes to test this using another geostationary satellite: WGS-3, at 12 ° west. It has a very strong beacon that can be used to test an RX system.

Peter Smits: The "whining" of the motor control via the Harry Arends software has now been solved by increasing the PWM frequency from 1 to 10 kHz. Sometimes a P-FET in the H-controller gets very hot, that still needs to be looked at.

Wim Bravenboer: asks where you can best order parts as a non-company. Ben calls Digikey for VCXOs, Mouser.

Further, Wim wants a dish of 2 feeds such as, for 8.4 GHz, and 8 GH z. These frequencies, however, are located close enough to each other to receive the two frequencies with a single feed.

Elmar: Has now constructed a UV light with a single 5W LED for making printed circuit boards. With reflective sides of the box, the light beam is distributed as evenly as possible over the PCB surface. That is not perfect, but the used photosensitive printed circuit boards (negative) can handle some "overexposure".

Ben: has a nanoVNA purchased , which operates up to 900 MHz, for just 35 Euros. Soon there will be a new version on the market which can handle 3 GHz .

Arne: shows a DC motor seen by Arduino which can be controlled using PWM. The motor is equipped with a pulse generator so that it is suitable for a rotor system.

Closure .

After this, the New Year is celebrated with a drink and snack and there is still a lot of discussions until about 3 pm.

Rob Alblas
(secretary AI)

Members meeting report March 14, 2020.

Opening by the chairman.
Due to the Corona virus, only 11 members are present . The canteen, which is usually busy during lunch break, remains virtually empty today. We have have had discussions whether we should let the meeting go and expecting that few people would decide to come that this is justified.
The exhibition in Rosmalen on March 21 has been canceled . The visit on 2 and 3 july to Eumetsat is also not certain, hopefully we will know more about this at the end of April .

Setting the agenda
No changes.

Administrative affairs
Nothing unusual.

Satellite status
Arne is not present . Elmar reports that Meteor-MN2-2 no longer works for both LRPT and AHRPT; the cooling of the satellite is defective, possibly due to a meteorite impact.

Other
Ben brings greetings from Peter Kuiper in Curaçao on . He asked if we can do the meeting via Skype. Another option could be Teamspeak. In this way we could involve people who would not otherwise be able to come to our meetings.
According to Timo, it is very easy to set up a Skype connection. Actually, we should connect the sound system to that. Something to find out.

Any other business

Peter Smits purchased at AliExpress a PCB with a double motor control for 12 euros; suitable for driving DC motors in a rotor control unit. The feedback is still to be added. As a test he has run this driver for hours and it works well. The FET's are not getting hot.
Ben bought a Nanovna. The minivna can only do one thing at a time, (S11 or S21 measurement), the Nanovna can do that at the same time. On the other hand, the insulation is worse from 500 MHz on (own radiation) compared to a normal DG8SAQ VNA. A newer version is coming that can measure up to 6 GHz.

Siglent comes with a Spectrum Analyzer with built-in VNA, up to 2 GHz. Interesting to check out; a lot more expensive but then you also have an SA.

Rob: has been working with Arduino software for a rotor control. Basis is an adapted version of the Harry Arends program. The control can be used for both azimuth / elevation and X / Y rotor systems. There is also an option to have the return pulses generated by the same Arduino, so that the software can be tested without real motors. It is also possible to get an actual pass through the software and have a graph made of the rotor movements.

Closure .

Rob Alblas
(secretary AI)

After this a discussion about rotors takes place . This will be reported in a next Kunstmaan.

satellietstatus

Arne van Belle, March 16 2020

POLAIR	APT (MHz)	HRPT (MHz)	Overkomst
NOAA 15	137.620	1702.5	Morning/evening, HRPT weak + sync problems
NOAA 18	137.9125	1707.0	Early morning/afternoon
NOAA 19	137.100	1698.0	noon/night
FengYun 3A	-	1704.5	AHRPT 2.80 Msym/s
FengYun 3B	-	1704.5	AHRPT 2.80 Msym/s
FengYun 3C	-	1701.3	AHRPT 2.60 Msym/s
FengYun 3D	-	7820.0 X-band	noon MPT 30 Msym/s
Metop-A	off(137.100 LRPT)	1701.3	LRPT/AHRPT 2.33 Msym/s
Metop-B	-	1701.3	Alleen AHRPT 2.33 Msym/s
Metop-C	-	1701.3	Alleen AHRPT 2.33 Msym/s
METEOR M N2	137.100 LRPT	1700.0	LRPT QPSK 72k /MHRPT
METEOR M N2-2	off(137.900 LRPT)	1700.0	LRPT OQPSK 72k /MHRPT
NPP	geen	7812.0 X-band	HRD 15 Mbps
JPSS-1/NOAA 20	geen	7812.0 X-band	HRD 15 Msym/s

NOAA 15, 18 and 19 are the last satellites that still broadcast APT.

METEOR M N2-2 has been hit, most likely by a micro-meteorite. It changed orbit suddenly en is depressurized. They have control back but due to overheating of the batteries they had to switch off LRPT. MHRPT is only on when solar panels are lit

NPP (NPOESS Preparatory Project) and JPSS-1 (NOAA-20) only broadcast on the X-band at 15 Mbit/s. A tracking dish with a diameter of 2.4 meters is recommended! [2]

FengYun 3A, 3B and 3C broadcast AHRPT, this can only be received with the new QPSK receiver from Harrie and Ben. This AHRPT is not entirely according to the standard so that even a Metop AHRPT receiver is not suitable for the FY-3 series!

FengYun 3C also has a different data rate than 3A and 3B and broadcast on X-band with LHCP. Rob Alblas has expanded his GODIL decoder and can now demodulate HRPT, Meteor HRPT, METOP and FY3A / B and FY3C in the 1700 MHz band!

Like NPP and JPSS-1, FY-3D only broadcasts on the X-band!

GEOSTATIONAIR	APT (MHz)	(SDUS)/PDUS (MHz)	Baanpositie
MET-11 (MSG-4)	no LRIT	1695.15 HRIT	0 degree, operational
MET-10	no LRIT	1695.15 HRIT	9.5 degree E, RSS
MET-9	no LRIT	1695.15 HRIT	3.5 degree E, RSS parallel operation
MET-8	no LRIT	1695.15 HRIT	41.5° degree E, IODC
GOES-E (no. 16)	1686.6 GRB	1694.1 HRIT	75.2 degree W via Eumetcast
GOES-W (no. 17)	1686.6 GRB	1694.1 HRIT	137.2 degree W via Eumetcast
GOES 14	1691 LRIT	1685,7 GVAR	105 degree W, Backup
GOES 13	1691 LRIT	1685,7 GVAR	60 degree W, Backup
GOES 15	1691 LRIT	1685,7 GVAR	128 degree W parallel with GOES 17
Elektro-L2	1691 LRIT	1693 HRIT	78 Degree E, via Eumetcast
Elektro-L3	LRIT	HRIT	165.8 degree E, in test phase
MTSAT-1R	1691 LRIT	1687.1 HRIT	140 degree E, Backup for MTSAT2
MTSAT-2	1691 LRIT	1687.1 HRIT	145 degree E, via Eumetcast
Himawari-8	no LRIT	no HRIT	140.7 degree E, via HimawariCast
Himawari-9	no LRIT	no HRIT	140.7 degree E, Backup for 8
Feng Yun 2E	-	-	86.5 degree E, Backup
Feng Yun 2F	-	-	112.5 degree E, Backup
Feng Yun 2G	-	-	99.5 degree E
Feng Yun 2H	-	-	79 degree E
Feng Yun 4A	1697 LRIT	1681HRIT	99.5 degree E, Operational

Unfortunately, DVB-S and most "DVB-S2 without VCM" receivers are no longer usable for EUMETCast. With a special driver, some recent DVB-S2 receivers can still be made suitable for Basic Service Only. (only the TBS-5980 and Skystar 2 eXpress HD, unfortunately this does not apply to the Skystar HD USB box)

The signal at 10 degrees east has a larger bandwidth and is therefore weaker than before.

Recommended dish diameter is 80-90 cm for Basic Service and at least 120 cm for High Volume Service 1 and 2

The 2nd EUMETCast TP2 transponder is set to 11387.500 MHz Horizontal and broadcasts HVS-2. The Symbol Rate and mode is the same as HVS-1 (33000 kSym/s DVB-S2, CCM mode, MODCOD 16APSK2 / 3).

For good reception the same applies as for HVS-1, in good weather a 90 cm dish is sufficient, but a 120 cm is recommended.

After requesting, users can receive live GOES 16 and 17 data on TP1 / HVS-1. Unfortunately this is in NetCDF format. In addition to SNAP, EUMETCastView by Hugo van Ruys can also display this. [3]

David Taylor has written the excellent GOES ABI Manager for Goes 16 and 17 NetCDF data. [4]

Due to "congestion" in the TV satellite world, we see that more and more transponders are being used on Eutelsat 10A. For optimum signal quality (SNR) you must rotate (Skew) the LNB in such a way that vertical transmitters are weakened as much as possible. A moderate or poor quality LNB can suddenly cause problems if it has poor attenuation for the vertical signals. This is called Cross-polarization. This value should be better than 22 dB and indicates how much a vertical transmitter is weakened if the LNB receives horizontally.

Dishes smaller than 120 cm have a larger opening angle and may experience more interference from neighboring satellites.

Eumetsat recommends repeating the fine alignment of your dish every year and paying attention to the correct rotation (Skew) of the LNB. If possible, also check the focus (sliding in and out towards the dish).

If the old SNR values are no longer achievable, it may be necessary to replace the LNB with one with better "Cross-polarization Isolation". [5]

With a splitter you can connect a second receiver to the same dish / LNB and receive Transponder 2 at the same time. The same PC runs 3 instances of Tellicast, for BAS, for HVS-1 and for HVS-2. If you also want to save all data then you must use a ram disk and multiple hard disks or a fast SSD.

The TBS dual or quad tuner cards are able to receive both transponders at the same time and have a build-in splitter/switch. Unfortunately the Ayecka SR1 cannot decode both TP1 and TP2 although it has dual tuners.

Eumetsat has released an update for Tellicast, TC 2.14.5. In addition to improvements, the license can handle up to 500 Mbit/s instead of 200. The channel files are also completely revised. Make a backup of your old ini and channels file in advance! The software update arrives 2x every day on Eumetcast on "Info-Channel-1"

This update is only necessary if you have problems with the reception of HVS-1 or 2.

If you have problems with Tellicast, Eumetsat advises you to upgrade first.

Eumetsat is now testing with the addition of certain Metop-C and Meteor-M N2 data, which will soon also be available via EUMETCast.

Himawari-8 images are now broadcast every 10 minutes via EUMETCast. Because this concerns all 16 spectral channels with a resolution of 2 km, these are transmitted via HVS-1 under channel E1H-TPG-2. Unfortunately, this stopped the half-hourly Himawari-8 images on the Basic Service on 10 October.

GOES 16 channel B01 is now available so that you can make "real" RGB images.

With effect from 15 January 2019, a license is no longer required for the hourly Meteosat data.

For the more frequent data and that of many other satellites, however, a license (including 3 annual renewal) is required. You still need your EKU for this.

Now that we have had the spring "solar outage" for EUMETCast it is recommended to check your LNB for damage ! A burst cover can be repaired using plexiglas and transparent silicone.

[1] Meteorontvangst met RTL dongle
[2] Info van NOAA20
[3] EUMETCastView
[4] GOES ABI Manager
[5] EUMETCast Europe Link Margins Explained.

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