Tuesday, April 21, 2020

Analog Algorithms. Artworks and writings

Writings and images for an ongoing submission for June 2020 Special topics issue "Algorithmic" in a SciArt magazine.

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Distance to the center of the Sun 148,144,412 km

Distance to the center of the Earth 405,175 km

Moon light (at 12:00 am) 9.7%

Growing moon phase

Age of the Moon (days after the new moon) 3

By the evening of Wednesday, February 26, the ashy light was clearly visible on the Moon. (being written for the next time)

On Thursday, February 27, Venus and the lunar arc are 6 ° apart and shone for a long time in the evening sky as they went to bed almost four hours after the Sun.

Quantum physics is the general name for a set of physical theories born in the 20th century which describe the behavior of atoms and particles and allow us to elucidate certain properties of electromagnetic radiation.

Like the theory of relativity, the so called: quantum theories mark a break with what is now called classical physics, which combines the physical theories and principles known in the 19th century: notably Newtonian mechanics and Maxwell's electromagnetic theory and which did not make it possible to explain certain physical properties.

Quantum physics covers all the fields of physics where the use of the laws of quantum mechanics is a necessity to understand the phenomena at play. Quantum mechanics is the fundamental theory of the particles of matter constituting the objects of the universe and force fields animating these objects.

Theory of relativity.

The concepts put forward by the theory of special relativity include several things:

Space-time: space and time must be perceived as forming a single entity.

The speed of light in a vacuum is invariable, regardless of the speed of the observer and the light source.

The calculations show that then it is also the maximum speed of movement, that it is reached only for light or any notion devoid of mass, and must be considered as the maximum speed of movement of information.

Measurements of various quantities relate to the speed of the observer. In particular, time expands and space contracts.

The concepts put forward by general relativity theory include:

The space-time curves all the more as the mass in the vicinity is large.

Gravitation influences the flow of time.

Information is a concept of the discipline of "information and communication sciences" (SIC).

In the etymological sense, information is what gives form to the mind.

It comes from the Latin verb informare, which means "to give form to" or "to form an idea of".

Information refers to both the message to be communicated and the symbols used to write it.

It uses a code of meaningful signs such as an alphabet of letters, a base of numbers, ideograms or pictograms.

Out of context, it represents the vehicle of data as in information theory.

And without support, it represents an organizational factor, which allows everything to be linked to others by the information exchanged.

This touches on a fundamental meaning, where a sum of aggregated information becomes a subject.

Information can be coded by various means such as words, numbers, gestures, a computer program, colors or any other means of communication.

Being both message (organizational factor) and messenger (vehicle), information could be defined as: What links our experience of the world with the world itself.

It was Archimedes who first proposed an algorithm for calculating π5.

Algorithms developed mainly in the second half of the 20th century, as a conceptual support for computer programming, as part of the development of computers during this period.

Donald Knuth, author of the treatise The Art of Computer Programming which describes a large number of algorithms, helped, with others, to lay the mathematical foundations for their analysis.

These three notions "correction", "completeness", "termination" are linked, and assume that an algorithm is written to solve a problem.

Termination is the assurance that the algorithm will finish in a finite time.

The proofs of termination usually involve a strictly decreasing positive integer function at each "step" of the algorithm.

Given the guarantee that an algorithm will end, proof of correction must provide assurance that if the algorithm ends by giving a proposed solution, then that solution is correct - that is, it is actually a solution to the problem posed.

The proof of completeness guarantees that, for a given problem space, the algorithm, if it finishes, will give a solution for each of the inputs.

The main mathematical notions in the calculation of the cost of a precise algorithm are the notions of domination (noted O (f (n)), "big o"), where f is a mathematical function of n, variable designating the quantity of information (in bits, number of records, etc.) handled in the algorithm.

Quantum computing is the sub-domain of computing which deals with quantum computers using phenomena of quantum mechanics, as opposed to those of electricity exclusively, for so-called "classical" computing.

The quantum phenomena used are quantum entanglement and superposition.

The operations are no longer based on the manipulation of bits in a state 1 or 0, but of qubits at the same time in a state 1 and 0.

Therefore..

A qubit or qu-bit (quantum + bit), sometimes written as qbit, is the quantum state which represents the smallest unit of quantum information storage.

It is the quantum analog of the bit.

A qubit compared to a conventional bit cannot be duplicated.

This is doubly impossible:

It is impossible to read a qubit without permanently freezing its state (since after measurement the qubit is projected into the measured state)

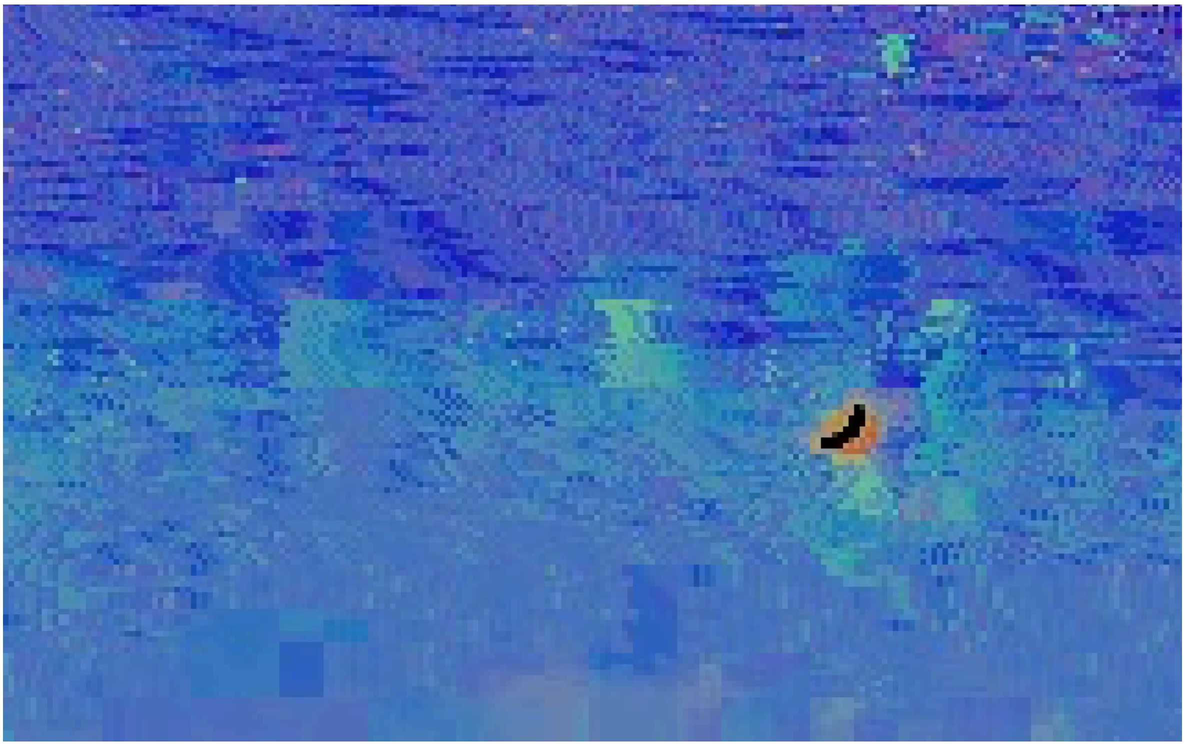
A single qubit measurement gives (and cannot give) any information.

On the other hand, it is possible to transport the state (the value) from one qubit to another qubit (the first qubit is reset), by a quantum teleportation process. But this process gives no information.

The challenge of quantum computing is to design algorithms, and the physical structures to execute them, such that all the properties of the superposition are used for the calculation, the qubits having to be in the execution at the end of the execution.

State giving the calculation result without risk of obtaining a random result.

We can for example cite the applications of qubit in cryptography, in particular with the BB84 protocol.



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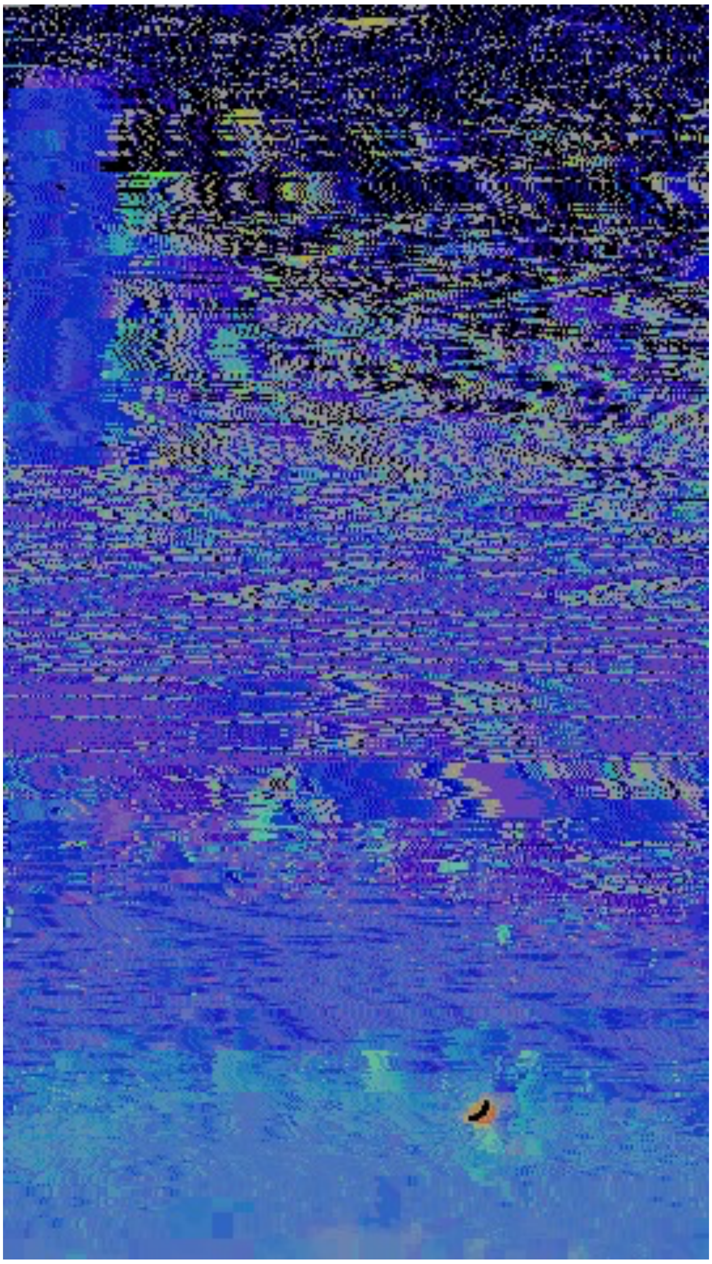

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Image information coding.

The element coded on 1 bit has only 2 possibilities: black or white.
The element coded on 2 bits has 2x2 possibilities: 4 colors

The 4-bit element has 2x2x2x2 possibilities: 16 colors
The element coded on 8 bits has (2 power 8) possibilities: 256 colors
The element coded on 24 bits has (2 power 24) possibilities: more than 16 million colors

A set of 8 bits represents 1 byte. So 16 bits = 2 bytes and 24 bits = 3 bytes.

The pixels.

A pixel (or dot in English) is a point.

A digital image is a collection of pixels.

The higher the pixel density, the better the definition of the image.

This density is commonly expressed in dpi (dot per inch), .

The inch is 2.54 cm.

A good paper support cannot distinguish more than 150 dpi (blotter effect ...)

To obtain a photo of 6x4 inches (about 15x10 cm) of almost maximum quality, a file of 900x600 = 540000 pixels = 0.5 Mpixels is therefore sufficient.

Each pixel is defined by a combination of 3 basic colors (Red, Green and Blue), each being coded on a byte, which makes it possible to distinguish 256x256x256 = 16.8 million colors.

A raw file corresponding to a 10 Mpixel photo will be around 30 Mbytes, that's big!

To limit its size, we "compress". For example, the "jpg" algorithm reduces the volume of the raw file in an adjustable ratio from 3 to 100 (from 6 to 20 in practice, a high ratio degrades the quality).

With a 10 Mpixel camera, you can print in A3 format (rare use), but you can also zoom in on part of the photo.

An HD screen should be 1920x1080 = 2 Mpixels. Please note that the trade names of televisions are misleading.

We are talking about HD and even full HD with a resolution of only 1366x768 = 1 Mpixels.

The name "4K" can correspond to various realities. We can only trust the native definition expressed in pixels.

Channels are generally broadcast by internet operators in 1440x1080 pixels. With fiber, we are starting (2018) to see certain programs broadcast in real HD (1920x1080 pixels).

Distribution of photos.

The quality of the photos found on the internet is often poor: .jpg files of only 100 to 300 kbytes. Below, they are thumbnails.
The reason is technical (storage volume, download time), but above all commercial.

Museums, for example, seek to protect a lucrative activity (postcards, books, etc.) by distributing only a few good quality photos, or even by prohibiting photographs by visitors.

One can wonder if the disappointing quality of the photos of certain publications (and their format far from the standard A4) does not aim to hinder the scans and photocopies.

The consequence is that copyright is thus further extended by those who should disseminate the culture.

Of course, the number of pixels is not enough to make a good photo. You also need good lighting, a tripod, a good angle of view.

Movies.

The VHS video cassette offered only well-defined quality.

Recording on VHS reduced the number of pixels by a factor.

When the DVDs arrived, the number of pixels became equivalent to a TV program.

With blu-rays (HD), the quality is "perfect", how will we make the consumer pay again? The solution has been found with complex protections which limit the use of the blu-ray.

The music.

Audio CDs (media of around 700 Mbytes) have been sold since 1982. With the digitization algorithm used, they have a capacity of 74 minutes of music, roughly the same as that of 33 rpm vinyl records.

The mp3 algorithm allows you to put on the same support 4 to 20 times more music depending on the compression chosen. It has been widely used since 2000 for downloading music from the internet, free or paid.

It would be easy to sell music on high-capacity media: double-sided DVDs (their capacity is 10 times greater than CDs) and mp3 algorithm.

We would have 50 to 100 hours of very good quality music for the price of making a 74-minute CD. We don't do it for commercial reasons.

Computer coding of colors.

The coding of a pixel can be done on 32 bits, of which 24 bits are used to code the color, the remaining 8 bits being:

Either unused or, with the representations (OpenGL, DirectX) and / or the image formats that allow it (such as PNG), to encode transparency information called alpha channel.

24 bit color coding.

The explanations given will therefore correspond not only to the representation of the colors on 32 bits but also to that on 24 bits.

The 24 bits of a color are broken down into 3 times 8 bits:

8 bits are devoted to the primary red tint
8 bits are devoted to the primary green shade
8 bits are devoted to the primary blue tint.

An 8-bit sequence makes it possible to code an integer between 0 and Vmax = 255: indeed, 28 is worth 256.

Consequently, the value of the red component of a pixel can be represented according to 256 different levels

(ranging from 0 , no red, at 255, maximum intensity red)

And it is the same for the other 2 primary components, green and blue.

There are two main families of color representation, such as they can appear in an image presented on a computer screen: RGB three-color coding, the principles of which have just been described, and coding perceptual Light saturation tint (or HSL) based on the artistic and psychophysical classifications of color perceptions.

RGB coding corresponds to the physical means for producing color in computer peripherals: at input (color scanner, digital camera, camcorder, etc.) as at output (color screen, printer, four-color, color photocopier, etc.)

TSL coding, intended for human operators, is adapted to the

characteristic of their vision.

The TSL description models present simplified parameters, adapted to computer color coding, and allowing to quickly convert RGB to TSL and return.

The pixel is often abbreviated p or px.

It is the basic unit for measuring the definition of a digital matrix image. Its name comes from the English phrase picture element.

The pixels are approximately rectangular, sometimes square. Their size can be changed by adjusting the screen or the graphics card.

Usually, the size of the screen is indicated by giving the length of the diagonal, in inches for computer equipment.

Memory occupancy of a pixel.

Black and white: a bit on a screen called monochrome or green or amber on a black background.
16 colors (VGA standard): 4 bits.
256 colors (or 256 levels of gray, which amounts to the same in terms of memory occupation): 8 bits (1 byte)
65,536 colors (thousands of colors): 16 bit
16,777,216 colors (16.7 million colors, true colors): 24 bit.

The actual memory space used may be larger. For example, in 16 million color mode, the pixel sometimes occupies 32 bits (4 bytes), the additional byte being unused, or used to encode transparency. Professional cameras record up to 16 bits per color, or 48 bits.

This is valid for the visible information of the pixel, color and transparency, but internally, depending on the system, for example at Silicon Graphics, using 16 bits per color component, an alpha channel, the Z-buffer, quad buffer and 3D stereo and system control bits (for stacking windows etc.), we can go up to more than 640 bits / pixel.

Formula: 2 the power of the number of bits equals the number of colors.

In CSS, the pixel unit (px) has been dissociated from the hardware pixel in order to compensate for the growing diversity of screen resolutions (pixel density)

Thus, when the size of a CSS element is expressed in pixels, the rendering will be similar regardless of the pixel density (resolution) of the display device.

The W3C defines the pixel as 1-96 of an inch.

This has led some browsers to introduce the concept of physical pixel-logical pixel ratio (dppx)

Isometric perspective.

Isometric perspective is a method of perspective representation in which the three directions of space are represented with the same importance.

A certain number of video games (such as Zaxxon, Marble Madness, or even Crafton and Xunk) using characters use an objective view in isometric perspective.

We often speak in this area of: perspective 3/4

From a practical point of view, this allows you to move the graphic elements (sprites) without changing their size, which was essential when computers were weak, and is still of great interest for pocket consoles.

However, this poses some confusion problems (due to the flattening of the image, the depth is rendered by a displacement in the plane)

Because of the pixelation, and for the sake of optimization of the calculations, certain games make the axes progress in a ratio of 2: 1, these are therefore inclined at an angle of 26.6 ° (arctan 0.5) instead of

30 °

It is therefore not isometric perspective proper, but a dimetric perspective (another type of axonometric perspective), but the term "isometric" is however used by abuse of language.

There is an artistic advantage.

Although not strictly limited to isometric video games, pre-rendered 2D graphics may have higher fidelity and use more advanced techniques than those possible with commonly available computer hardware, even with hardware acceleration 3D activated.

Like modern CGIs used in motion pictures, graphics can be rendered once on a super computer or powerful rendering farm, and then displayed on less powerful consumer hardware, such as tablets and web browsers.

This means that static pre-rendered isometric graphics often look better compared to their real-time rendered counterparts, and can age better over time compared to their peers.

However, this benefit may be less pronounced today than it was in the past.

One drawback of pre-rendered graphics is that, as display resolutions continue to increase, static 2D images should ideally be rendered to keep pace, or otherwise suffer from pixelation.

This is however not always possible as it was the case in 2012, when BioWare by Baldur Gate (1998) was redone in the door of Baldur: Enhanced Edition by the studio Beamdog.

The new developer opted for a simple scaling of 2D graphics, or zoom, without restoring the game sprites, because they lacked the game's original creative artistic assets.

(The original data was lost during a flood) Changing the resolution of a game rendered in real time is trivial, by comparison.

While the history of computer games has seen some real 3D games as early as the early 1970s, the first video games to use the distinct visual style of isometric projection in the sense described above were arcade games in the early 1980s.

The use of isometric graphics in video games began with the appearance of Sega by Zaxxon, released as an arcade game in January 1982.

It is an isometric shooter where the player flies a space plane through the scrolling levels. It is also one of the first video games to display shadows.

The treasure island of Data East used isometric visuals in 1981, but may not have been published worldwide.

Another game is the early isometric Q * bert, which Warren Davis and Jeff Lee started programming in April 1982 and released in October-November 1982.

Q * bert shows a static pyramid from an isometric perspective, with the player controlling a character who can jump on the pyramid.

The following year, in March 1983, the Congo Bongo isometric platform arcade game was released, running on the same hardware as Zaxxon.

It allows the player character to move through larger isometric levels, including real escalation and three-dimensional fall.

The same is possible in the arcade title Marble Madness, released in 1984.

2D (left) and 3D (right) coordinates of a typical dimetric video game sprite.

At that time, isometric games were no longer exclusive to the arcade market and also entered personal computers with the release of Blue Max for the 8-bit Atari family and Ant Attack for the ZX Spectrum in 1983.

In Ant Attack, the player could move forward in any direction of the scrolling game, offering complete free movement rather than fixed on an axis as with Zaxxon.

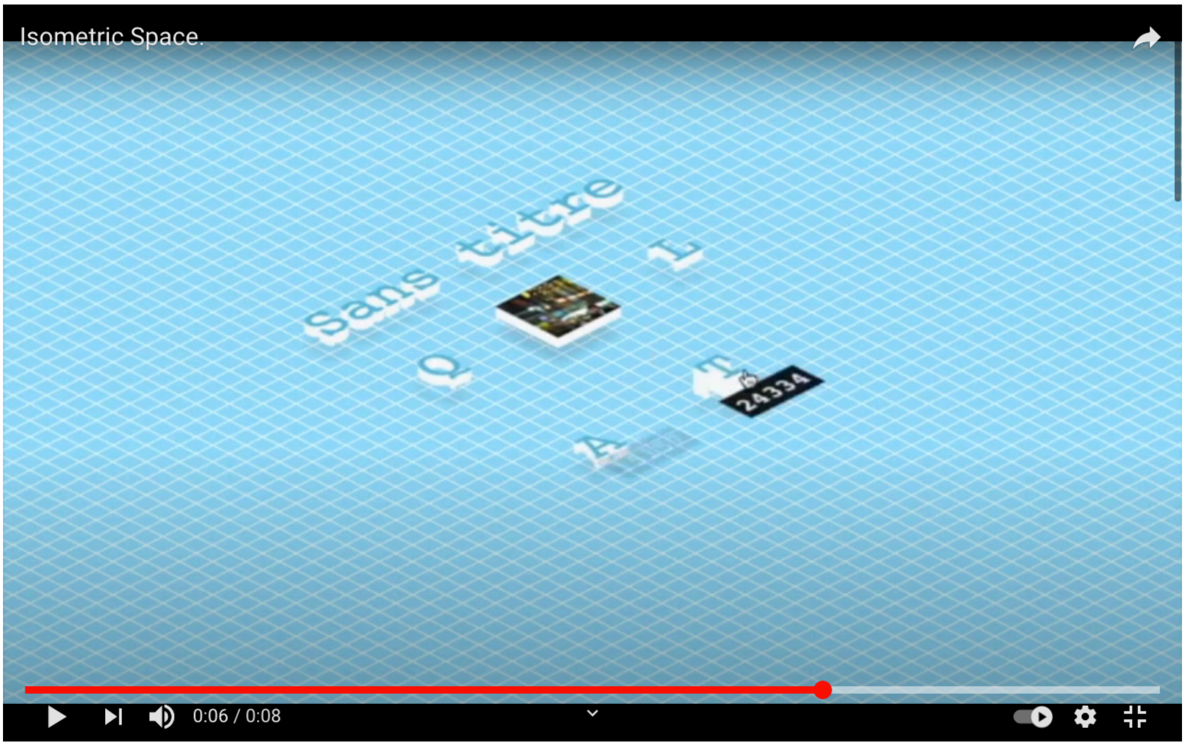
Views can also be changed around a 90-degree axis.

ZX Crash magazine therefore awarded it 100% in the graphics category for this new technique, known as: Soft Solid 3-D

Also in the 1990s, isometric graphics began to be used for Japanese role-playing video games (JRPG) on console systems, especially tactical role-playing games, many of which still use isometric graphics today.

Examples include Front Mission (1995), Tactics Ogre (1995) and Final Fantasy Tactics (1997), the latter using 3D graphics to create an environment in which the player could freely rotate the camera.

Other titles such as Vandal Hearts (1996) and Breath of Fire III (1997) carefully emulated an isometric view, but in fact used perspective projection.



Isometric Space. youtu.be/NuC61qBX9NA

50 years ago: The computer that took Man to the Moon.

Sky sample.

The more you increase the gain, the more the dynamics are reduced.

If the dynamic range becomes close to 8 bits or less, it is no longer useful to capture 12 or 16 bits and even that would reduce the pace in some cases: doubly counterproductive.

Fast planetary (high gain) images gain nothing from being captured in 12 or 16 bits.

In deep skies not too fast, it is often important to have dynamics.

In fact it is the opposite of the deep planetary sky:

We need 8 bit raw (12 or 16 bit deep sky) and ROI to keep only the number of active pixels necessary for the planet, which is very small,

which greatly increases the bit rate.

As the exposures are ultra short, it is difficult to fill the pixels.

Also with modern CMOS cameras, the more you increase the gain, the more the reading noise decreases.

On the other hand, the dynamics decrease at the same time.

In short with the new planetary cmos we can make ultra short exposures thanks to the very low reading noise.

So what we do in planetary:

1) the exposure time is adjusted as a function of the turbulence

2) the gain is increased until filling the histogram to 70 or 80% i.e. not far from the max, but without saturating

3) we capture in 8-bit RAW and .ser file -> this gives the best frame rate.

So we have a maximum of image.

In lunar it will be similar with exposure times 10x shorter, between 0.5ms and 2ms.

The space programs of the 1960s developed at a time when computers were advancing rapidly.

Thanks to it, the techniques of guidance and navigation have made a considerable leap, as well as the programming, the driving and the transmission of unguided then automated tasks.

And for good reason, without the help of on-board navigation and piloting computers, the success of the Apollo 11 mission would have been impossible.

When starting Apollo missions, it was essential for NASA to have an extremely powerful computer that could be integrated into spacecraft.

In 1961, MIT was appointed to design and build an on-board navigation and piloting computer, which would become the AGC:

Apollo Guidance Computer, the first computer to use integrated circuits.

Interestingly, the contract established by NASA did not contain any specification as to how to design such a machine for the simple reason that, at this point, NASA did not really know what the specifications of the computer should be.

Apollo programs! It was in 1963 that MIT defined more precisely what the MCO should be, namely, on the one hand, a computer designed to control, test and operate a guidance system; and on the other hand, determining and applying modifications to the speed of a spacecraft in order to optimize its performance during a lunar mission.

However, the necessary software and programming techniques did not exist and therefore had to be designed from scratch.

Apollo Guidance Computer.

In fact, MIT developed 2 AGCs: one was located in the command module and formed the center of the vessel's guidance, navigation and control system.

The second was located in the lunar module and made it possible in particular to control the landing and the ascent back to the command module as well as the mooring.

The AGC receives its main information from the inertial system as well as from two radars, when these are activated.

Using navigation programs for each phase of the mission, it is thus able to pilot the main engines and the orientation engines in direction and thrust, so that the ship follows the trajectory that has been calculated.

Astronauts use a console to enter the various instructions: launching a navigation program, requesting information, resetting the position, entering the flight parameters to be executed, etc.

The MCO was structured in two parts containing different modules.

The first part contained in particular a volatile memory module (current RAM memory) and a non-volatile memory module (current ROM memory)

The second part of the AGC contained 24 logic modules, 5 interface modules and 2 power supplies.

The non-volatile memory of the AGC was a string memory with magnetic cores.

This type of memory was the dominant form of computer RAM for some 20 years (1955 to 1975)

In summary, this memory tinyurl.com/c7fxn7y4 was made up of small toroids (rings) of ferrite crossed by conductive wires.

The direction of the electric current passing through these wires made it possible to magnetize the toroids and to write and read information there.

This memory being woven by hand, writing and assembling a program took several months.

In a magnetic core memory each core corresponds to a data bit.

The toroids can be magnetized in two different directions (clockwise and counterclockwise)

The bit recorded in the torus is zero or one depending on the direction of the magnetic field.

The wires passing through the toroids are arranged to allow magnetizing the toroids and to read the direction of the magnetic fields by sending electric currents in the wires.

Compared to a standard 32 GB of current ram memory.

Compared to a standard 1 TB capacity hard drive today.

The integrated circuit (or electronic chip) is an electronic component, based on a semiconductor, often integrating several types of basic electronic components in a reduced volume (on a small plate), making the circuit easy to implement.

At the time of the Apollo 11 mission, MIT engineers did not see fit to incorporate the use of rendezvous radar during the moon landing, while the astronauts had the opposite reasoning.

In fact, in the event of an aborted landing, it would have been vital for them to be able to recover the control module on the correct trajectory!

Coded pulse modulation.

A bitstream, also called a binary sequence, is a sequence of bits.

A byte stream is a sequence of bytes.

Typically, each byte is an amount of 8 bits (bytes), and therefore the term byte stream is sometimes used interchangeably.

A byte can be encoded as an 8-bit sequence in several different ways (see endianness), so that there is no single, direct translation between bytestreams and bit streams.

Bit streams and secondary streams are widely used in telecommunications and IT.

For example, synchronous bit streams are routed through SONET and the Transmission Control Protocol carries an asynchronous broadcast stream.

Pulse modulation and coding or MIC, generally abbreviated as PCM, is a digital representation of an electrical signal resulting from a digitization process.

The signal is first sampled, then each sample is quantized independently of the other samples, and each of the quantized values is converted to a digital code.

The independent processing of each sample implies that there is neither encryption nor data compression.

Raw MIC (PCM) data files are found especially in audio applications.

In telecommunications (PSTN or VoIP), these are flows: the sample blocks are transmitted to the queue, without specifying the start or the end.

In stereophonic or multichannel systems, the sample blocks corresponding to each channel are multiplexed.

WAV, AIFF and BWF files indicate in the header the type of data encoding.

Most often, the audio data in pulse modulation and coding are fragments (chunks) multiplexed sample by sample.

Coding.

Most often, this code is a binary number; several types of binary code are in common use, depending on whether the signal is considered in relation to the extreme value, without sign, or to its median value, in positive or in negative, and in this case, either with a bit sign, or in addition to 2n.

Both for the transmission of the codes and for their magnetic or optical recording, it is preferable that there are no long sequences of 1 or 0.

These sequences make it difficult to reconstruct a clock signal from the transitions.

In audio, extreme values are only rarely reached.

Codes composed entirely of zero or one generally correspond to these extreme values.

Pulse modulation can be transmitted with Manchester coding, which avoids constant level periods at the cost of doubling the frequency.

With a little more economy, the 8-bit modulation on 14 bits, used in the compact disc ensures that there are two, four, six, eight or ten zeros per block of fourteen bits representing each byte.

These codings suitable for recording or transmitting data can easily be reduced to an array of binary values.

Telecommunications.

Alec Harley Reeves filed the first patent for this technology in Paris in 1937.

It sampled the telephone signal at 6 kHz on 5 bits.

The first speech transmission by MIC was carried out with the SIGSALY voice coding equipment used for high level Allied communications during the Second World War.

The first deployment of pulse code modulation for the telephone dates back to 1962 in the United States, after the passage from the electronic tube to the transistor.

When the cost of the circuits is high and a reduction in the sound quality is possible, it may be useful to compress the speech signal.

We then use methods based on the detection of correlations between samples.

The oldest methods, used in telephony, only examine the signal level.

If the coding considers more than one sample, it is no longer a question of Coded Pulse Modulation (PCM).

Delta modulation.

Differential pulse-code modulation (or delta) (DPCM), unlike linear modulation LPCM, codes PCM values as differences between the current value and the previous value.

For audio, this type of encoding reduces the number of bits required by about 25% compared to PCM.

Adaptive Differential Pulse Code Modulation.

For more reduction, at the cost of more processing, we use an ADPCM algorithm to place a series of 14 bits linear PCM
(or 8 bits in µ or A law) in 4 bits ADPCM.

Each PCM signal section is transmitted with a header which indicates the correspondence table to be used.

In this way, we almost double the capacity of the line.

The G.726 standard describes the details of the process.

Later, when it was found that compression rates could be further increased, additional standards were published.

In mobile telephony, codecs with compression (AMR or AMR-WB) are used.

There is no MIC / PCM flow between the devices.

Posted by Veronica IN DREAM at 2:47 AM