

# Systematic Innovation



**e-zine**

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The Systematic Innovation e-zine is a monthly, subscription only, publication. Each month will feature articles and features aimed at advancing the state of the art in TRIZ and related problem solving methodologies.

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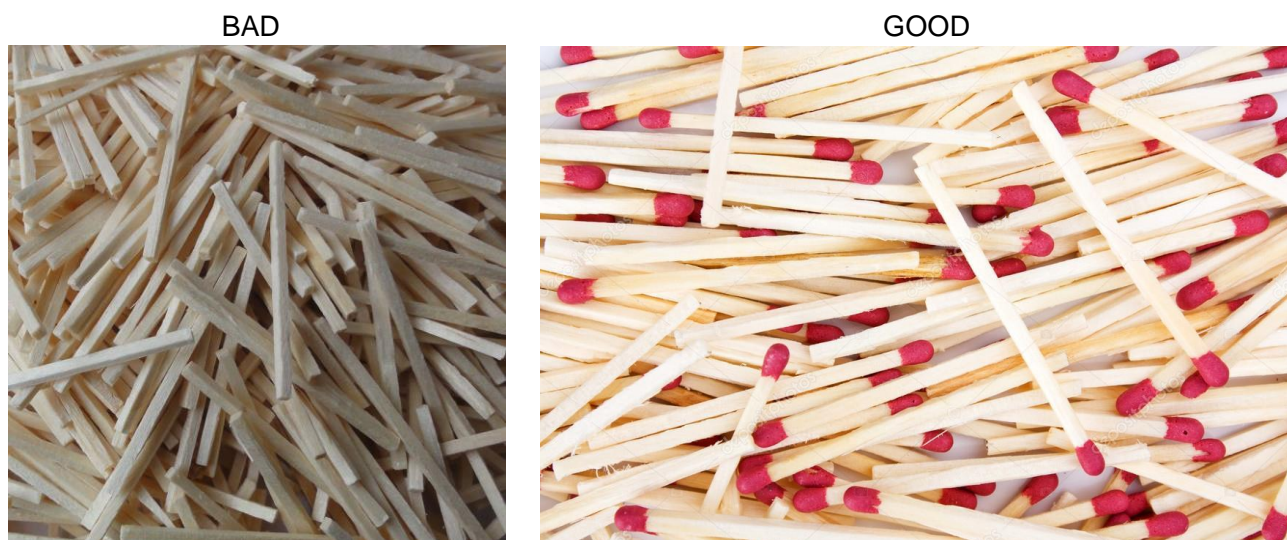
Readers' comments and inputs are always welcome.  
Send them to [darrell.mann@systematic-innovation.com](mailto:darrell.mann@systematic-innovation.com)

# S-Fields & System Evolution

Truth be told, I'm not the world's biggest user of the S-Field tool. I find myself teaching it far more often than I am using it in anger. Partly, I think, because other tools have kind of superseded S-Fields, but perhaps, too, because it hasn't had the benefit of being updated like most of the other parts of TRIZ now have. There is, of course, Iouri Belski's 'Improve Your Thinking' book (Reference 1), but its job is mainly to attract people to what already exists rather than complement what existed in classical TRIZ with what exists in the rest of the world. In fairness to Belski, he has added some 'intangible' Fields to the story, but I'd have to say that any time I've tried to intrigue anyone other than engineers or chemists with S-Fields it has been an unmitigated sea of blank faces, and the thought of exposing Marketers strikes me as somewhat surreal.

It's a pity because the S-Field way of thinking is very useful in the context of one of our themes of the year, 'getting to the first principles'. In many ways the S-Field model is the ultimate version of first principles thinking, offering as it does the very definition of a minimum system.

I was running a short section of a workshop on S-Fields again the other week, which meant running a version of the 'get the right number of good matches into the box' case study – Figure 1. As usual, once given a list of the possible fields that could be used to achieve the required, everyone manages to configure a host of different solutions possibilities.



**Figure 1: How To Separate 'Good' and 'Bad' Matches?**

As usual, also, there was the inevitable debate at the end of the exercise regarding whether the 'Classical TRIZ' solution of adding ferromagnetic particles to the ignition compound in the tip of the good matches and using magnets was the best of the bunch. (Not to mention the frequent comment that seemingly every Classical TRIZ solution involves either ice or magnets!)

Part of the debate centres around whether matches are the best solution in the first place to the ultimate customer need of 'making fire', and another part focuses on whether the

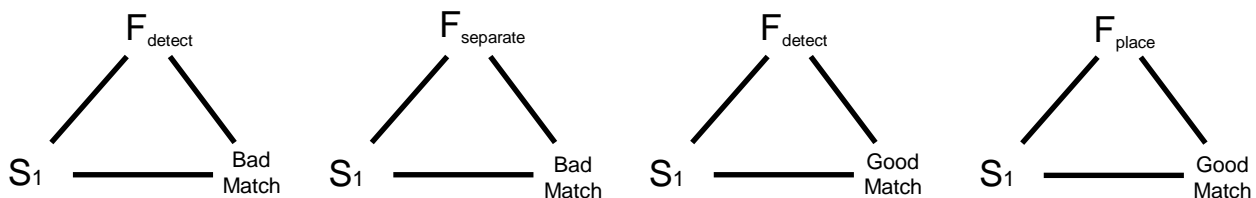
problem is actually the process that puts the ignition compound on to the head of the matches isn't good enough and needs to be evolved. Both are perfectly legitimate points of discussion, but really aren't anything to do with the exercise in its posed form. (By the way, I never cease to be amazed by peoples' willingness to explore the problem at other hierarchical levels when it isn't their own, but point-blank refuse to do the same thing when it is their own problem!)

So, once we get over this phase and recognize that we're forcing ourselves to solve the problem at the initial level, we can finally get to the issue of why magnetism is better than centrifugal, mechanical (usually some kind of grid system where the bad matches fall through) or any other kind of field. How might the S-Field tool really help in this kind of situation?

The problem is about getting the right number of good matches into the box. In order to achieve this goal, four sub-functions are required:

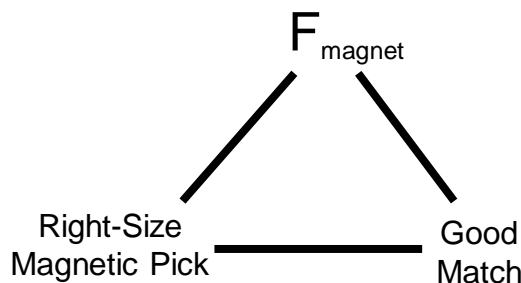
- 1) Detect bad matches
- 2) Separate bad matches
- 3) Detect the right number of good matches
- 4) Place the good matches in the box

Each of these functions 'demands' the existence of a complete S-Field model. In which case, we potentially need to find four substances and four fields:



**Figure 2: Four Functions, Four S-Fields**

In the light of this potential need, the attractiveness of the ferromagnetic particles solution starts to become apparent: By choosing a magnet of the right size to pick up the right number of matches, we can effectively end up with one S-Field model to achieve all of the required functions – Figure 3:



**Figure 3: Four Functions, One S-Field**

## Reference

- 1) Belski, I., 'Improve Your Thinking: Substance-Field Analysis', [www.triz4u.com](http://www.triz4u.com).

# Case Study: Law Of System Completeness Hierarchies

Constructing Function and Attribute Analysis (FAA) models is one of my least favourite TRIZ-related activities. At the same time as trying to avoid drawing them, I also know it's the most important problem definition job I have to do. A frequent short-cut involves trying to draw a minimal model featuring as few components as possible. This is good for focusing in on a problem symptom, but not so good from the perspective of avoiding unwanted side-effects when we fix a problem in one part of a system and unwittingly create a new problem in another part that we had failed to model.

A good heuristic to keep in mind when deciding where to draw the boundaries of your next FAA model involves making use of the Law of System Completeness, and specifically, making sure that all of the six essential elements are present for the main useful function you're modelling.

To take a simple example, let's say we're looking to construct a model of a windscreen wiper system for an automobile. The main function of this system is clearing the screen from whatever environmental contaminants might be present. A typical system model might then look like the one illustrated in Figure 1:

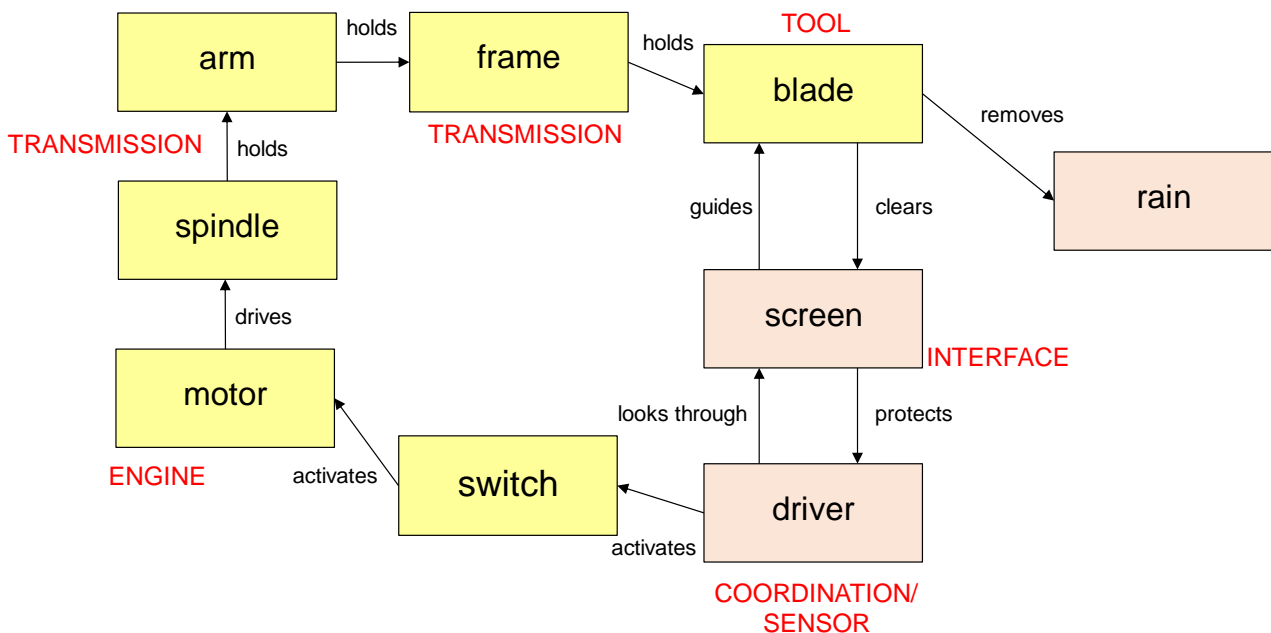


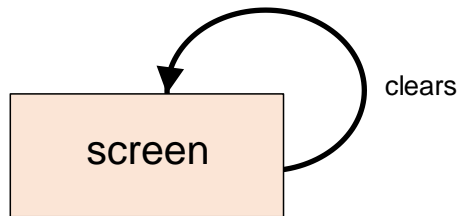
Figure 1: Exemplar Function Analysis Model Showing LoSC Elements

Clearly, there are more components we could have chosen to add to this model, but we've drawn the boundary where we have because we can see that the elements that allow us to deliver the 'clear screen' function are all present. The screen represents the Interface; the thing that does the clearing job is the blade ('Tool'); the Tool is powered by a motor ('Engine'); the Engine and Tool are connected by a cluster of ('Transmission') components – motor spindle, blade-arm and frame – and the whole system is Coordinated by the driver, who Senses when there is a need to switch the wiper system on.

In some vehicles, the driver might have been replaced by a rain-sensor and a software algorithm that tells the motor when to switch on, but the Law Of System Completeness nevertheless continues to apply. And as such our model would be well advised to feature all six of the essential elements.

That said, having the six elements present doesn't necessarily imply a need for six components. In the Figure 1 example, the driver fulfils both the coordination and the sensor functions. The sensor 'component' in this case has in effect been subsumed into the complex system that is the human operator.

As the windscreen wiper system evolves towards its ultimate Ideal Final Result, it is the case that progressively more of the components of the original system will disappear. In the ultimate situation, we will likely end up with the FAA model illustrated in Figure 2:



**Figure 2: IFR Windscreen Wiper System**

Although this hypothetical Ideal Final Result screen now only possesses one 'component', crucially, the six elements required by the Law of System Completeness must necessarily still be present. The trick is that they will have shifted to the sub-system level.

Let's imagine, for example, that the self-clearing screen becomes possible by adopting something like the Lotus Effect shown in Figure 3.



**Figure 3: Lotus Effect**

If we were to now construct a FAA model of this system, it might look something like the image illustrated in Figure 4. The model has been constructed by using the Law Of System Completeness as a checklist: most visibly, the Interface in this new system has now become the rain and the Tool is provided by the 3D protrusions on the surface of the glass. Finding the 'Engine' is a little more difficult, but we know it must be there because 'something' has to provide the 'field' (source of energy) that our minimum system must contain. A little knowledge of the Lotus Effect will tell us that our 'field' in this case is all

about surface energy, which in turn is about judicious design of the 3D protrusions to make van der Waals forces work to give us a surface tension effect on the water droplets so that they don't wet the surface.

So far so good. Next up comes the 'Transmission'. This is the 'thing' that will connect the Engine to the Tool. In this context, it is the underlying structure provided by the glass sheet that is doing this job.

This leaves us with apparently missing Coordination and Sensor elements. These are clearly rather more subtle. The Coordinator in the LoSC is the 'thing' that controls the delivery of the useful function. There is no specific component doing this job in a Lotus Effect windscreen, but rather the useful function is delivered 'automatically' by orienting the glass at an angle that ensures the rain runs off the surface. Which in turn tells us that part of the 'Engine' must also be gravity.

Finally, we're left with 'Sensor'. Here, at the IFR solution, we see that the 'need for measurement' is eliminated because the system inherently delivers the desired behavior. In this sense, the Coordination function of the glass incorporates the sensor: as soon as a water droplet arrives, the glass 'knows' and the van der Waals forces do their thing.

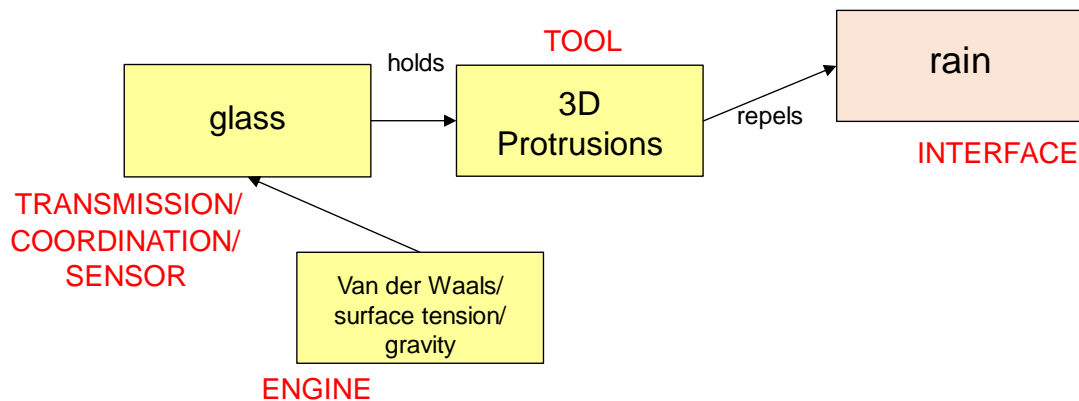


Figure 4: LoSC-Based FAA Model For Self-Clearing Screen

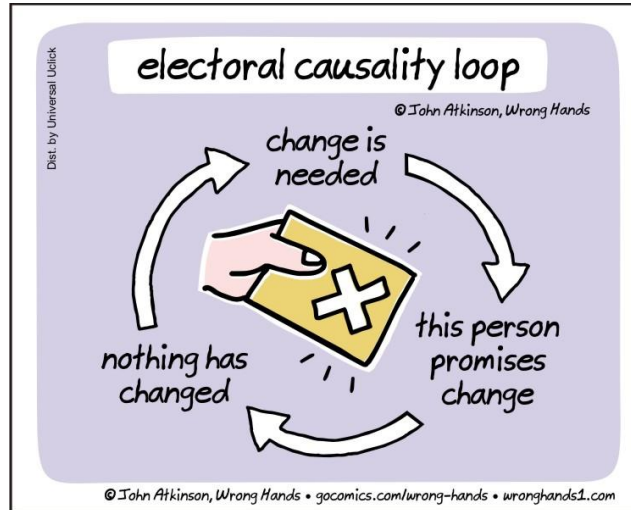
Figure 4 now offers the basis for a continuation of the evolution of the screen. We know, for example, that the Lotus Effect by itself probably is insufficiently effective (in its current form at least) to deliver some of the other functions of the windscreen. Not least of which would be the 'high-speed insect impact' problem and the need to keep the screen clear of organic matter. At which point we realise that, if we're to successfully also achieve this function, we must also satisfy the Law of System Completeness. And that takes us full circle back to the first article this month... can we get one complete system to deliver multiple functions?

Like, for example, switching to autonomous vehicle designs that don't require the driver to see through a screen anymore. Or at least not using a sheet of clever glass.

## Not So Funny – Feedback Loops

Feedback loops are an essential element of any and all complex systems. Its always a good idea to understand what loops are in place. And which new ones you can create.

2017 has been a year of some quite bizarre politics. Which for some strange reason reminds me a lot of this feedback loop:



Speaking of politics, I think this is my favourite new product of the year...

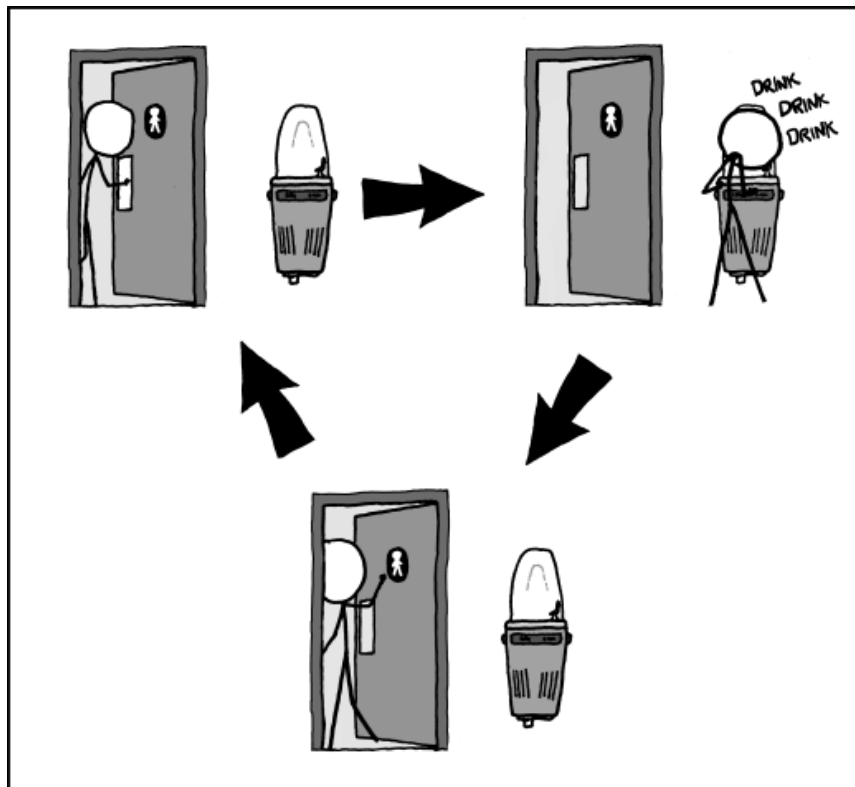


...I loved it even more once I learned the full – feedback loop – story: Trump Paper is a new brand of toilet paper created by the lawyer Antonio Battaglia. Battaglia is based in Guanajuato, Mexico. He conceived the new product as a way to support migrants and those who have been deported from the United States.

After hearing much of the anti-immigration rhetoric coming from Donald Trump during his

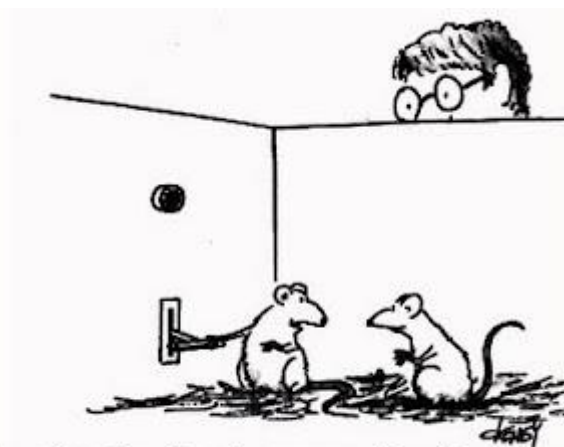


Here's a new version of the old Gary Larson 'Steady State' cartoon... I'd have to say Larson understood the concept of 'Time Constant' better



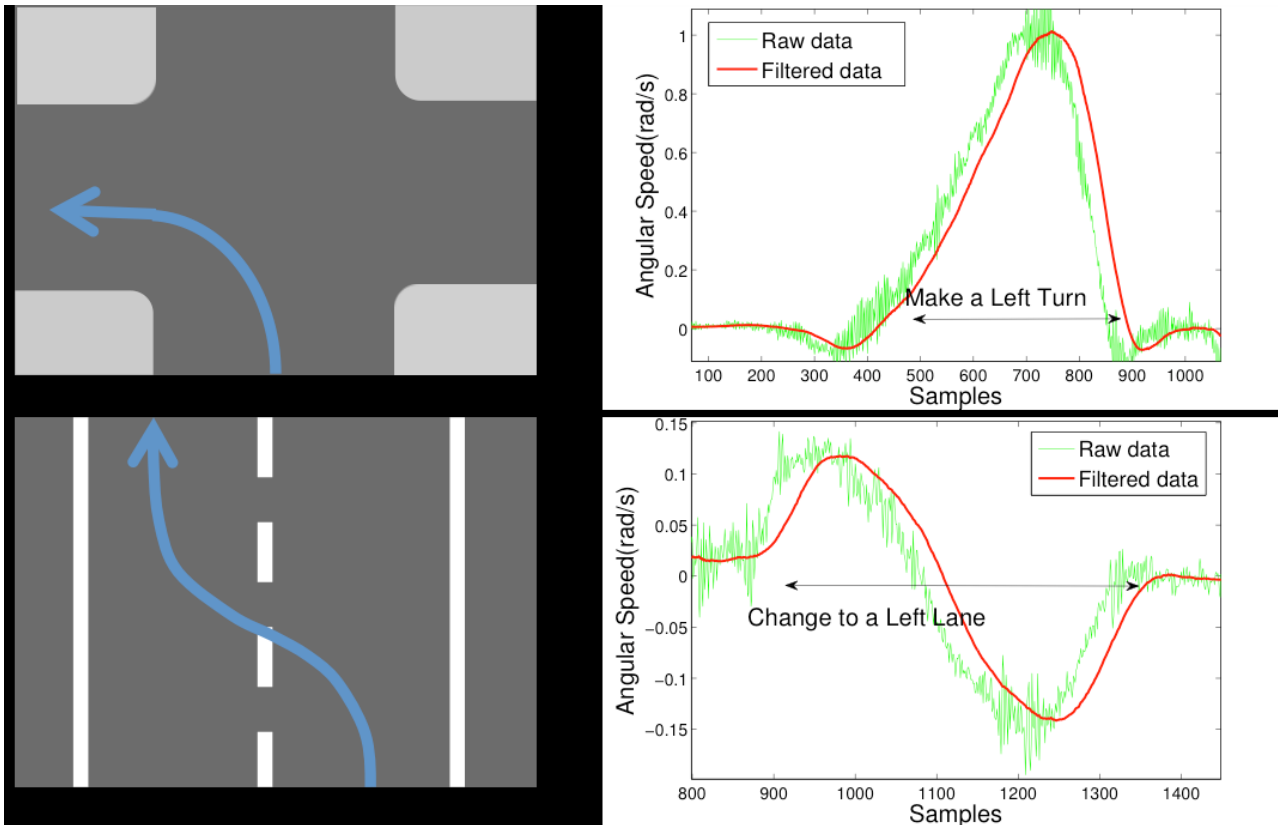
I AVOID DRINKING FOUNTAINS OUTSIDE BATHROOMS BECAUSE I'M AFRAID OF GETTING TRAPPED IN A LOOP.

...unlike this rather insightful example of what happens when we combine Inventive Principle 13 with the Hawthorne Effect. Douglas Adams would be proud.



It's a rather interesting phenomenon. Every time I press this lever, that post-graduate student breathes a sigh of relief.

## Patent of the Month – Smartphone Detection Of Vehicle Maneuvers



There's an awful lot of talk these days about autonomous vehicles. A lot of it is naïve. We won't all be driving around in autonomous vehicles in the next five years – or even ten – because there are too many legal, moral and ethical contradictions to be worked through. The fact that over 3% of the population currently earn a living by driving might also be a factor: where are those millions of people going to go? That said, we know it will happen eventually. Which means that any interim solutions can only ever be just that: interim.

This month's patent of the month is such a solution. It originates from a pair of inventors at the University of Michigan. US8,834,222 was granted on December 5. Mention the word 'Michigan' and we automatically think 'automotive'. That said, the patent highlights an increasingly familiar story in the automotive industry: the winners are the non-automotive providers. In their bid to work towards autonomous vehicles, the industry has tended to focus internally, and has tried to engineer solutions using resources they can add to a vehicle. The problem is that the best and most appropriate resources already exist in the smartphones we all carry around. Which means that no matter what the automotive industry might try and do, they find themselves fighting an ever more difficult to win battle. So, while the automotive OEMs are busy fitting expensive camera and sensor systems to their top end vehicles, the University of Michigan trump them all by demonstrating that an everyday smartphone can already do what they're trying to do.

Here's what the inventors have to say about the problem under consideration:

*Automobiles bring a wide range of conveniences as well as fatalities. In 2012, the reported number of fatalities from road accidents was 30,800 in the U.S. alone. Of these fatalities, 23.1% involved lane control--i.e., merging or changing lines or driving on curvy roads--and 7.7% involved turning*

maneuvers, i.e., turning left/right or making U-turns. In total 30.8% of the fatalities were related to vehicle steering maneuvers.

As most of these fatalities had resulted from the driver's careless or erroneous steering, those accidents could have been minimized or prevented if effective safety mechanisms had been deployed in the vehicles. There has been an on-going push for incorporating electronic safety features in vehicles to assist drivers' steering.

Many existing driving assistance systems, such as lane-departure warning or lane-keeping assistance, are exploiting the advanced built-in sensors (e.g., cameras, radars, and infrared sensors), or utilizing existing sensors on smartphones to detect the steering maneuvers in order to assist driving. However, these approaches suffer two limitations: many built-in sensors are only available on newer high-end cars, and hence such safety solutions cannot be applied to a wide range of type/year models of cars; and both built-in sensors and smartphone-based applications overly rely on cameras to get road information. Although such systems claim that smartphone cameras are sufficient in assisting the driver, they have limitations in terms of computational overhead and inaccuracy. The accuracy of camera-based approaches depends on visibility, thus render ineffective in various driving conditions with limited visibility.

Alternatively, smartphone sensors, such as gyroscope, accelerometer, magnetometer, etc., can be exploited to detect vehicle steering maneuvers and thus perform the same steering-assistance functionalities that would have been achieved with use of cameras. These camera-free approaches have advantages of requiring much less computational resources and power, and also being immune to visibility distortions. However, it is known to be very difficult to differentiate the steering maneuvers, which is one of the main reasons for camera-based approaches being most prevalent.

Which looks something like this when mapped on to the Contradiction Matrix:

IMPROVING PARAMETERS YOU HAVE  
SELECTED:

**Ability to Detect/Measure (49)**

WORSENING PARAMETERS YOU HAVE  
SELECTED:

**Measurement Precision (50)**

SUGGESTED INVENTIVE PRINCIPLES:

**28, 26, 32, 24, 3, 37, 10, 13, 18**

The Inventive Principle suggestions for which seem to align very elegantly with the solution generated by the inventors. Here's what they describe:

*A method is provided for detecting vehicle maneuvers using a mobile phone [Principle 24 – Intermediary] residing in the vehicle. The method includes: receiving signals from two or more sensors residing in the mobile phone while the vehicle is moving, where the signals are indicative of vehicle movement and reported relative [Principle 37 – Relative Change] to a coordinate system associated with the mobile phone [Principle 26 – Copying]; converting the signals from the two or more sensors from the phone coordinate system to a geographic coordinate system; deriving a detection signal indicative of angular speed of the vehicle about a vertical axis of the geographic coordinate system, where the detection signal is derived from the converted signals; correlating the detection signal to one of a plurality of predefined signatures [Principle 10 – Prior Action], where each signature represents a different maneuver made by a vehicle; determining a direction*

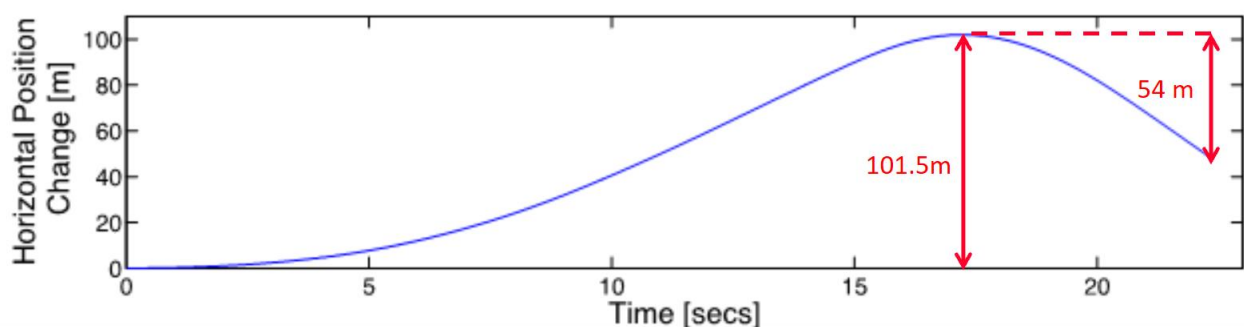
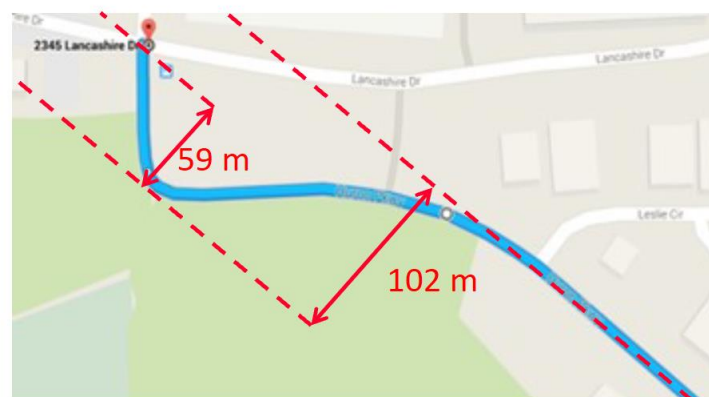
of travel for the vehicle; determining a horizontal displacement of the vehicle relative to the direction of travel; and identifying a maneuver made by the vehicle based on the correlation of the detected signal to one of the plurality of predefined signatures and magnitude of the horizontal displacement of the vehicle. The geographic coordinate system includes a vertical axis defined in relation to surface the vehicle is traversing upon and the vertical axis does not align with any of the axes that define the phone coordinate system.

Correlating the detection signal to one of a plurality of predefined signatures includes identifying one or two bumps [Principle 18 – Vibration] in the detection signal, where one bump correlates to turn by the vehicle and two bumps correlates to a lane change by the vehicle.

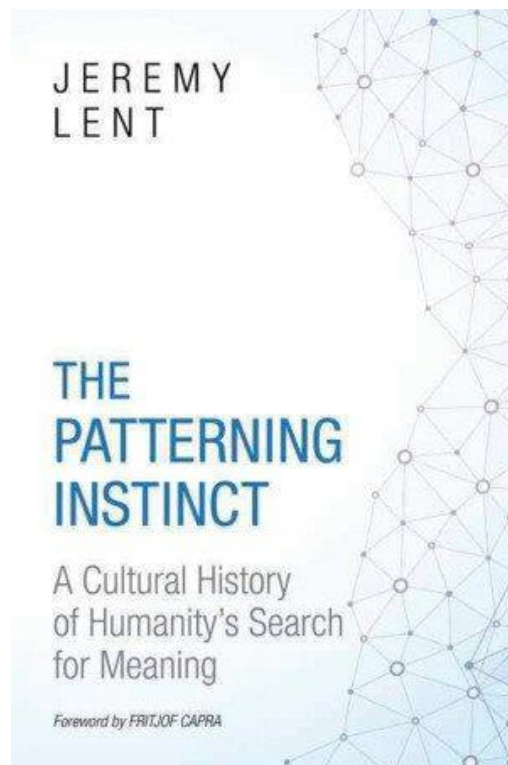
Vehicle maneuvers may be classified as either a lane change, a turn or a curvy road. Identifying a maneuver made by the vehicle includes comparing magnitude of the horizontal displacement to a threshold; and classifying the maneuver as a curvy road in response to a determination that the magnitude of the horizontal displacement exceeds the threshold. In one aspect, horizontal displacement is determined by determining velocity of the vehicle along the direction of travel; determining angular speed of the vehicle about a vertical axis of the geographic coordinate system; and determining horizontal displacement as a function of velocity and angular speed of the vehicle. Additionally, a turn may be further classified as either a right turn, a left turn or a U-turn based on a difference in vehicle heading angle between start and end of vehicle maneuver.

If reading through patents is not your thing, check out a very followable presentation of the solution here: <http://slideplayer.com/slide/4881856/>.

Meanwhile, sit back and admire disruption in action.



## Best of the Month – The Patterning Instinct



Seeing as some of us are heading in to the holiday season, and therefore, in theory at least, have a bit more time available to get stuck into a really big book, I thought I'd recommend a 442 page blockbuster this month.

Let's start with the daily turbulence of politics, economics, environmental change and religion rages around us. In such times there is an understandable marketplace for books that look at the bigger picture. Jeremy Lent's 'The Patterning Instinct' does just that, joining the dots between points in history and culture, identifying echoes and consiliences across the natural and social sciences.

This is more than a scholastic exercise. Our planetary predicament demands the broadest and deepest perspectives, not just to enable masterful armchair contemplation, but also to guide our actions in the middle of what would otherwise be an enervating horror show.

The cover of Lent's intellectual epic shows a line drawing of networks, the dots ostentatiously joined. Perhaps this expresses the author's first-principles thinking, derived from his scientific and cultural readings, about the power of connectedness. But on the way to a somewhat familiar end-point, Lent provides a useful and massively referenced road map of the most enduring structures of meaning in human history.

Humanity's first world-encompassing idea, says Lent, was the hunter-gatherer belief that "everything is connected". There followed an agricultural era during which humanity lived under the "hierarchy of the gods". He then charts what he calls "the divergence". Lent's shorthand for this pattern is "split cosmos, split human": the assumption that our physical reality, personal or objective, can be controlled by transcendent powers. Whether we call those powers "divine" or "rational" is, to Lent, neither here nor there. The two developed in lockstep: you couldn't have conceived one without the other.

Articulated first by the philosophers of Ancient Greece, this “Western pattern” of meaning gathered force under the rise of Christianity and the innovations of the Enlightenment and continues to hold sway under today’s scientific industrialism.

“This idea could produce a split humanity, one species enhanced and exploring, the other barely surviving”

Lent traces his splitting thesis all the way to the thrumming fortresses of Silicon Valley. Here, Plato’s fantasy – a rational soul subjecting the animalistic body to its will – is not just a moral compass, it’s become techno-scientific mission.

Are you extending our cognitive abilities by creating devices that mimic and mesh with our thinking? Are you influencing people’s emotions through mood-altering drugs? Are you engineering our bodies to the optimum with gene editing? Then you are in the grip of an ancient idea: that pure rationality stands sovereign over the biological world.

This idea has the potential, already half-realised, Lent says, to produce a split humanity, “one species, genetically and technologically enhanced, exploring entirely new ways of being human; the other species, genetically akin to us, barely surviving within its collapsed infrastructure.”

Similar to Yuval Noah Harari’s recent, and equally expansive, *Homo Deus*, Lent’s book seeks some perspective on our modern juggernaut of radical innovation and global polarisation. To do so, it reaches towards Asian wisdom traditions – an “Eastern pattern” that Lent calls “the harmonic web of life”.

But while Harari’s no-self Buddhism comes close to exulting in the way humankind will be overtaken by intelligent algorithms, Lent finds a place for connecting, meaning-seeking humans in this complex future. To carve out this space for ourselves, Lent says we must recast the deep metaphors structuring our attitudes to nature and other humans.

Neo-Confucianism is the candidate that Lent favours to lead this metaphorical revolution. Its core concept is an understanding of the universe as the interrelation of qi (spoken as “chi”) and li. Qi is the raw material of the universe – but li is “the ever-moving, ever-present set of patterns that flow through everything in nature and in all our perceptions of the world, including our consciousness”.

Like his mentor Fritjof Capra, who provides an introduction for the book, Lent seeks corroboration for this spiritual insight in what were once called the “new”, non-deterministic sciences – the study of complex adaptive systems in physics and biology, which find curious analogues in certain branches of mathematics.

Lent shows how the tenets of Neo-Confucian thought are homologous with maths, neuroscience and climatology, particularly when those disciplines identify “a complex of dynamical systems that remain valid across the entire natural world, from systems as vast as global climate to as small as a living cell”.

Like Capra, Lent wants to fuse spiritual tradition and the “new” sciences in service of a less rapacious and divisive world. If we could grasp what Lent calls elsewhere “liology”, we would attribute our ultimate sources of value not to “a transcendent realm”, or to our “moral rationality”, but to “humanity’s intrinsic connection with the natural world”.

There’s an obvious, real-world refutation available, of course. It’s not hard to find a regime that loudly deploys Confucian values in a modern setting. But does China, which recorded its highest ever figures for coal-fired electricity this April, provide the best exemplar? Lent himself delicately “refrains from making direct inferences regarding modern China” in his

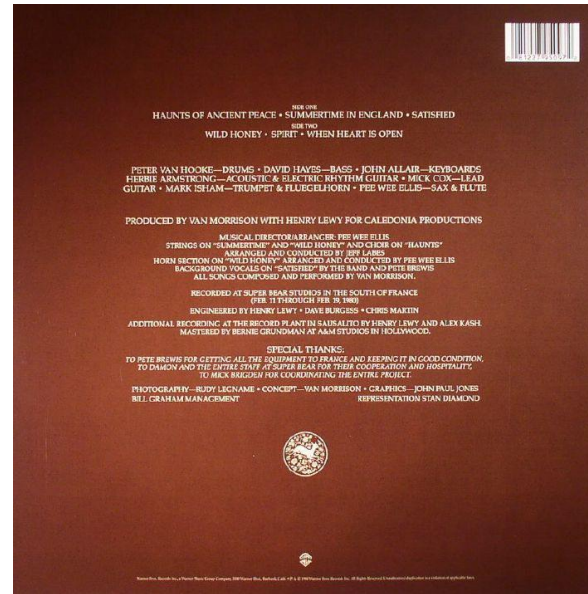
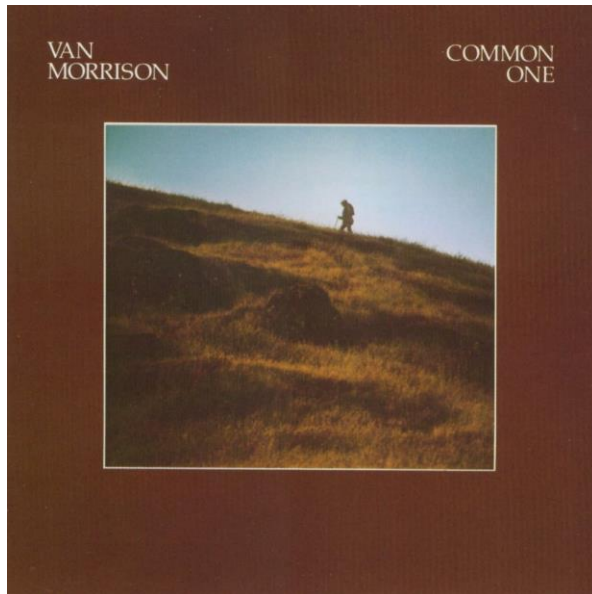
study of Neo-Confucianism. He should entertain a little more hope. Although China is producing more energy from coal in absolute terms, the percentage of total energy provided by coal is dropping.

Since 2007, Beijing elites have been hyping East Asia as a land mass uniquely placed to bring about an “ecological civilisation”, underpinned by the Confucian belief in harmony with nature. Meanwhile the administrations of US president Donald Trump and UK prime minister Theresa May have each rubbished climate change action and research. They have handed China a golden opportunity: to make good on its soft-power rhetoric and create a sustainable model that, sooner or later, the rest of the world will have to emulate. Lent uses what he calls “cognitive history” and “archaeology of the mind” to show how such massive shifts in underlying world view can happen, and they involve an evolutionary account of the brain. Again like Harari, Lent dates the advent of our capacity for advanced cognition to a point about 70,000 years ago, when our prefrontal cortex began to expand. Lent describes the “executive function” of the prefrontal cortex well. “It mediates our ability to plan, conceptualise, symbolise, make rules, and impose meaning on things. It controls our physiological drives and turns our basic feelings into complex emotions. It enables us to be aware of ourselves and others as separate beings, and to turn the past and the future into one narrative.” This is the locus of the “patterning instinct”.

In many of the neurology-informed history epics, authors are often studiously neutral about the raw mental ability of humans to forge new paradigms. Few of them dare to connect our cognitive flexibility to any necessary idea of progress, or human flourishing. This is perhaps understandable given what’s involved is often a survey of historical carnage. Lent himself is unsparing in his descriptions of the cruelty and brutality meted out by righteous monotheists and dualists, their meaning-patterns justifying colonialism and empire. “Cultures shape values, and those values shape history. Our values will shape our future” Given all this, you have to admire the way Lent sticks his neck out on behalf of Neo-Confucianism. He goes so far as to propose that its contradiction-resolving concept of “heart-mind”, which seeks to integrate emotion and reason, is analogous to the prefrontal cortex when it functions at its best. And he has a point, citing research that shows that a healthy prefrontal cortex is not about “repressing or overriding emotional states”, but about “integrating them into appropriate decisions and actions... our cognition takes place not in the brain but in the felt sensation of the entire body.”

The Patterning Instinct, oblivious to the science-deniers currently occupying high executive office, ends with a statement of simple confidence: “Cultures shape values, and those values shape history. By the same token, our values will shape our future.” One way to equip yourself for this heroic task will be to read this enormous, learned, yet garrulous and helpful book.

## Wow In Music – Summertime In England



In February 1980, Van Morrison and a group of musicians travelled to Super Bear, a studio in the French Alps, to record (on the site of a former abbey) what is considered to be the most controversial album in his discography. Coming in the wake of punk rock, the music press was merciless in its condemnation. The resulting album, *Common One*, was deemed to be over-indulgent, esoteric and willfully obscure. Later "Morrison admitted that his original concept was even more esoteric than the final product." The album consists of six songs; the longest, "Summertime in England", lasted fifteen and one-half minutes and ended with the words, "Can you feel the silence?". NME magazine's Paul Du Noyer called the album "colossally smug and cosmically dull; an interminable, vacuous and drearily egotistical stab at spirituality: Into the muzak." Greil Marcus, whose previous writings had been favourably inclined towards Morrison, critically remarked: "It's Van acting the part of the 'mystic poet' he thinks he's supposed to be." Morrison insisted that the album was never "meant to be a commercial album." Biographer Clinton Heylin concludes: "He would not attempt anything so ambitious again. Henceforth every radical idea would be tempered by some notion of commerciality."

The only problem was, the fans loved the album. To the point now where it is frequently voted amongst Morrison's best. And especially *Summertime in England*. It became a live favourite that was an almost constant feature in Morrison's set-list for the next twenty-five years. Over that time the basic song underwent – as one would expect from The Man – a whole series of evolutionary shifts. If you wanted to see and hear Van in his most improvisational and transcendent mood, *Summertime* was where you were bound to find it.

Morrison started rehearsing the song in November and December 1979 along with "Haunts of Ancient Peace" at club gigs in the San Francisco area. According to guitarist Mick Cox, "we did 'Haunts' and 'Summertime in England' in 4/4 time...Van brought it right down at the end to nothing, so he's just saying, 'Can you feel the Silence?' but he's still keeping the beat, and then Pee Wee Ellis takes his mouthpiece off and Mark Isham takes his mouthpiece off, and they're both making quiet percussive noises in time to the rhythm." Cox felt like the rehearsal performances were "far better than the final recordings." The

song on the album was recorded in February 1980 and according to Mick Cox the second take was the one used on the album. The spoken section is in 3/4 time that begins with John Allair's church organ fugue.

Morrison originally wrote the song as a poem about William Wordsworth and Samuel Taylor Coleridge making a literary trip to the Lake District in England where they worked together on the poems that were to become their landmark joint venture, *Lyrical Ballads*. Morrison has been quoted as saying, "[Summertime in England] was actually part of a poem I was writing, and the poem and the song sorta merged... I'd read several articles about this particular group of poets who were writing about this particular thing, which I couldn't find in the framework I was in."

The lyrics also refer to Jesus walking down by Avalon — an allusion by William Blake with the lines: "And did these feet in ancient time/Walk upon England's mountain green?" The lyrics verge between several layers of consciousness but always return to the central occurrence of a holiday in the country that the singer spent with his sweetheart (the "red-robed" Toni Marcus) and/or daughter.

Biographer Brian Hinton believes "The song leaves most classical rock fusions dead in the water." In an essay in 2000, Allen B. Ruch wrote that "the music is supported by a wonderful string section that completely avoids the treacle that strings can sometimes lend to songs like this. And as usual with Van Morrison's lyrics, passages that seem awkward or even silly on paper take on a soaring and majestic intensity when sung by Van in their proper place." It is quite simply, in my opinion, one of the most transcendent moments in the history of modern music.

There are several versions of *Summertime In England* available online. This one is an early version from Montreux in 1980: <https://www.youtube.com/watch?v=QMLaHEwEX7Y> Things to listen out for include the extraordinary ebb and flow (Principle 15) of the intensity of the performance, the (Principle 19) time signature shifts, Van's stream-of-consciousness repetition (Principle 20) of the key themes, the alternating sung and spoken portions (Principle 3) and the improvised fills of the different musicians.

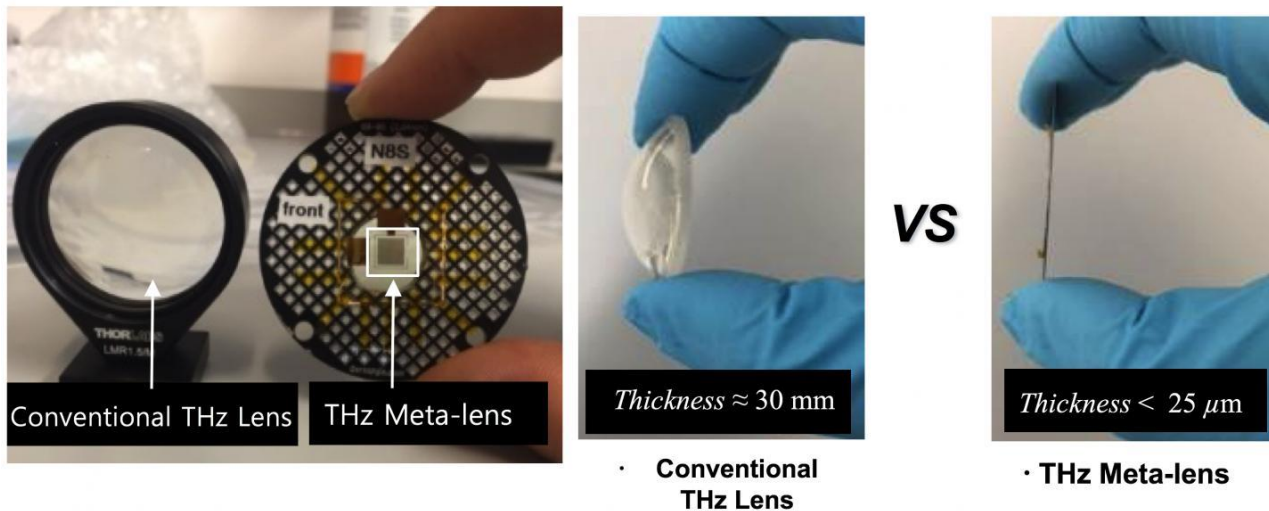
By 1998, a Rockpalast concert version shows how the song has been trimmed in length, but still manages to be a showstopper. Thanks in no small part to the signature call-and-response (Principle 26) between Morrison and Pee Wee Ellis. This part of the song often became the final climax of the set. You'll find the start of the song at 1:09 and if you want to cut to the call-response section, it occurs around 1:12.

<https://www.youtube.com/watch?v=hfXDqsBrVOQ>

My own favourite portions are when Van sings, "It ain't why why why why why why why / It just is," and he sings each *why* as if it were an individual animal. Watch how, in the Montreux version, he signals the band with a convulsive movement of his arm—Van's bands have always acted as sensitive ecosystems—and the horns reduce their volume to a spectral hum. Into the remaining space, arctic in its emptiness, Van leans toward his microphone and whispers, "Put your head on my shoulder, and you listen to the silence, Can you feel the silence?"

We can now.

## Investments – Graphene Meta-Lens



On the quest for miniaturization, scientists at the Center for Integrated Nanostructure Physics, within the Institute for Basic Science (IBS, South Korea), in collaboration with researchers from the University of Birmingham and the Korea Advanced Institute of Science and Technology (KAIST), develop credit card-thick, flat lenses with tunable features. These optical devices, made of graphene and a punctured gold surface, could become optical components for advanced applications, such as amplitude tunable lenses, lasers (i.e. vortex phase plates), and dynamic holography.

Meta-surfaces are new 2D materials that can effectively control the electric and magnetic components of light (and other electromagnetic waves) and bend them to bespoke directions. Controlling the beam's direction can bring out interesting phenomena; the most incredible being the "invisibility cloak effect," where light waves bypass an object recreating the image beyond the object, as flowing water in a river would bypass a stone. Published in *Advanced Optical Materials*, the study presents the properties of a meta-surface which works as a convex lens. Specifically, it is made of a gold sheet pierced with micrometer-sized U-shaped holes and covered with graphene. As the shape of common convex lenses allows light to be concentrated on a spot (or focus), think about a magnifying glass which can concentrate a light beam and even start a fire, so the particular pattern of the tiny apertures of the meta-lenses works by focusing the incoming beam.

In addition, these micro-holes can also change light polarization. While natural light is generally unpolarized before being reflected, the team used circularly polarized waves, that is a light beam where the direction of the electric field is corkscrew spiraling. This meta-lens can convert the left-circular polarization wave (going counterclockwise if seen straight in front) to right-circular polarization (clockwise). The researchers managed to obtain a conversion rate of 35%. Converting circular polarization could be useful in a number of fields, for example biosensing and telecommunications.

In order to control even more properties, the scientists took advantage of graphene's unique electronic features and used them to tune the output beam's intensity or amplitude. Here graphene plays the role of the exposure of a camera. In the case of the camera, a mechanical control allows a certain shutter's opening time and size to determine the

amount of light entering the instrument. These meta-lenses instead, regulate the exposure via an electric tension applied to the graphene sheet, without the need for bulky components. When voltage is applied to the graphene layer, the output beam becomes weaker. "While conventional optical lenses have a thickness of several centimeters to several millimeters, this meta-lens is just a few tens of micrometers thick. The intensity of the focused light can be effectively controlled, and it could find useful applications in ultra-small optical instruments such as microscopes, cameras, and tools used in very sensitive optical measurements," clarifies Teun-Teun Kim, the first author of the study.

The meta-lenses were designed for a type of electromagnetic wave, which falls in-between infrared radiation and microwave radiation, called terahertz radiation. This type of radiation can pass through some materials (like fabrics and plastics), but at a shorter depth than microwave radiation, for this reason it is employed for surveillance and security screening.

**Read more:**

Teun-Teun Kim, Hyunjun Kim, Mitchell Kenney, Hyun Sung Park, Hyeon-Don Kim, Bumki Min, Shuang Zhang. **Amplitude Modulation of Anomalously Refracted Terahertz Waves with Gated-Graphene Metasurfaces.** *Advanced Optical Materials*, 2017; 1700507 DOI: [10.1002/adom.201700507](https://doi.org/10.1002/adom.201700507)

## Generational Cycles – Deadhead Stickers On Cadillacs



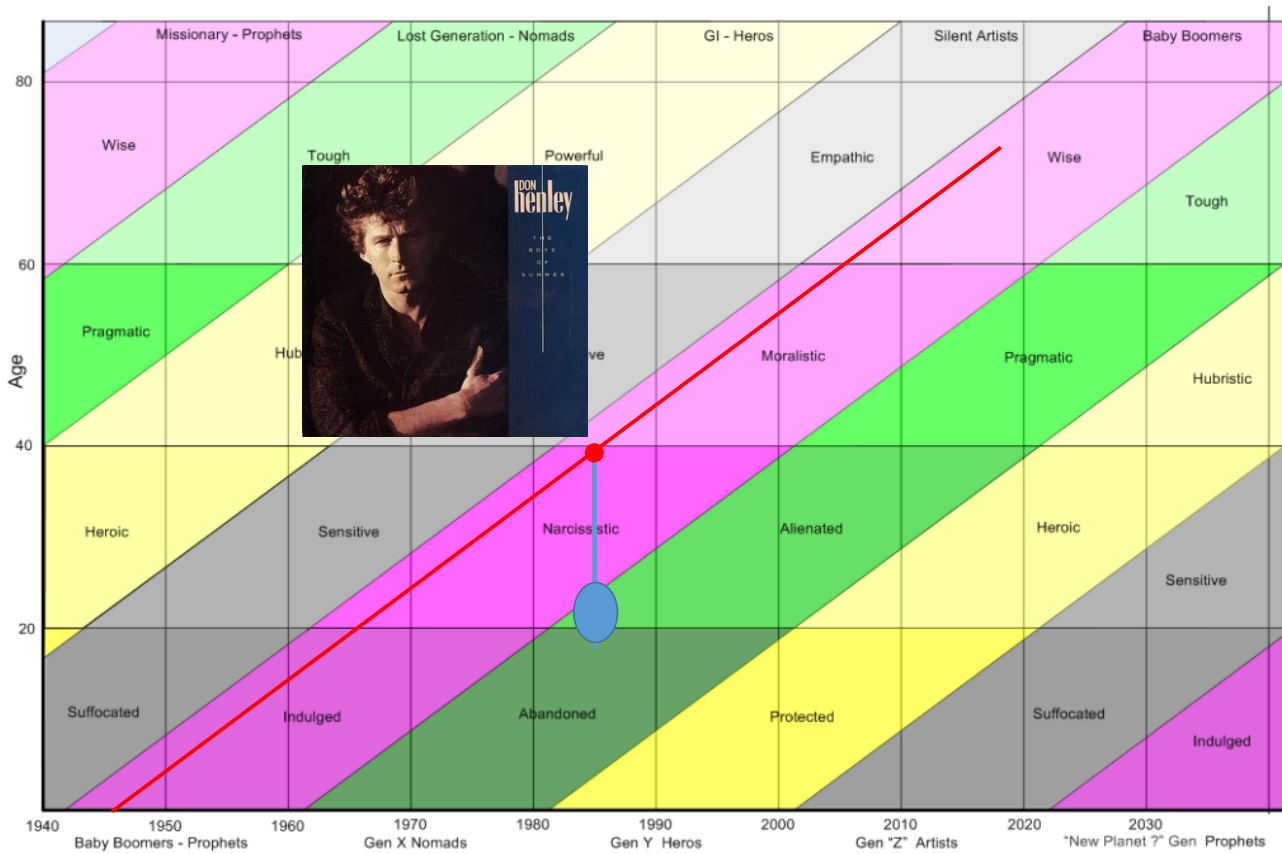
"I was driving down the San Diego Freeway and got passed by a \$21,000 Cadillac Seville, the status symbol of the Right-wing upper-middle-class American bourgeoisie – all the guys with the blue blazers with the crests and the grey pants – and there was this Grateful Dead 'Deadhead' bumper sticker on it!"

So said Eagles vocalist and drummer, Don Henley of his 1984 solo single release, 'The Boys of Summer'. It was the lead single from Henley's album *Building the Perfect Beast*, song was released on October 26, 1984 and reached No. 5 on the Billboard Hot 100 chart in the US as well as No. 1 on the *Billboard* Top Rock Tracks chart and number 12 in the UK Singles Chart. The song's music video won several awards. In 1986, Henley won the Grammy Award for Best Male Rock Vocal Performance for the song. "The Boys of Summer" was ranked No. 416 on *Rolling Stone* magazine's list of The 500 Greatest Songs of All Time. "The Boys of Summer" is also included in *The Pitchfork 500*, Pitchfork Media's "Guide to the Greatest Songs from Punk to Present." In other words, the song is pretty iconic.

The Henley quote comes from an interview he did with the *NME* in 1985. He called out the 'Deadhead sticker on a Cadillac' lyrics as an example of his generation selling out.

Henley was born in 1947, making him one of the early Baby Boomer generation. When the song was released, Henley was in his late 30s, on the verge of the 'moralistic' phase of his generation's life journey. While clearly a stab at his generation's selling out of the ideals of their Woodstock/flower-power youth, it more likely served as a signal moment for the next generation, the GenX Nomads. The song was released as the spearhead of this new generation was hitting their peak music-listening years. Punk had happened, and the previous generation of Boomer rock-stars were finding life tough in the new market of Nomad record-buyers. Some Boomers never made the transition. Others, like the Eagles, stuck to their generation. Henley, on the other hand, earned himself a whole career's worth of credibility with the X'ers. 'Not selling out' is one of the main characteristics of Nomads. Henley gave them the 'proof' that the Boomers had sold out. The evocative lyric

became something that would continue to be quoted for the next twenty years. A living reminder to everyone what the Boomers had done...



## Biology – *Lobarina scrobiculata*



The *Lobaria scrobiculata* lichen is unique. Unlike the majority of lichen with green microalgae, which use environmental humidity to activate their photosynthesis, this species requires liquid water in symbiosis to activate the cyanobacteria living in it. This makes it special, although it is not its only unique property.

A study, published in the journal *Annals of Botany*, reveals how this organism changes its reproductive strategy depending on whether or not there is rainfall. Thus, in dry places, this tree-dwelling lichen starts to reproduce in smaller volumes with greater intensity.

"We believe this is a response strategy to water scarcity," said Sonia Merinero, a researcher from the Rey Juan Carlos University (Madrid) and the University of Stockholm (Sweden), and the main author of the study.

In adverse environments with less rainfall, the lichen could be ensuring the persistence of its populations by means of early and intense production of reproductive structures which free small fragments of fungus and cyanobacteria which are dispersed together (soredia). "On the other hand, in rainy places favourable to the species, the lichen can thrive without reproducing as early, nor very intensely," the scientist affirmed.

In total, researchers analysed 9,665 lichens in 18 populations of *Lobaria scrobiculata* across 800 km, spanning the Iberian Peninsula. "We measured the size of each lichen in all populations and estimated its reproductive effort. By doing so, we calculated the reproductive threshold in each population, the minimum size required for a lichen to start reproducing with 50% probability," Merinero stated.

### The sexual life of fungi

The results also proved the theory of life strategies devised for sexually producing plants and animals for the first time. "This predicts how, in adverse environments, plants and animals with undetermined growth, such as fish and insects for example, start reproducing

in smaller volumes with a greater reproductive effort, guaranteeing their offspring in those adverse environments," the researcher commented.

Until now, this theory has never been proved in the fungi kingdom, and lichen are organisms which arise from a symbiosis between a fungus (mycobiont) and one or several green algae or cyanobacteria (photobionts). "What is curious about this and many other species of lichen is that it also reproduces asexually, indicating that the theory is versatile enough to also explain asexual reproductive strategies," Merinero pointed out.

The group of researchers highlight how, just like sexual reproduction in plants, this type of asexual reproduction is based on the production and dispersion of individual propagules (part of an organism which is produced sexually or asexually) which behave like seeds, and which does not share any similarities with clonal reproduction in plants, such as reproduction using stolons.

These conclusions broaden our knowledge on reproductive strategies in lichen, "organisms whose biology and ecology we still know little about, although they are found in all land ecosystems and carry out important ecological functions," the scientist concluded.

What we do know, from a contradiction solving perspective is that *Lobaria scrobiculata* has found a solution to a classic Productivity versus scarcity (absence of rain) conflict. Here's how the problem might best be mapped on to the Contradiction Matrix:

IMPROVING PARAMETERS YOU HAVE  
SELECTED:

**Productivity (44)**

WORSENING PARAMETERS YOU HAVE  
SELECTED:

**Amount of Substance (10)**

SUGGESTED INVENTIVE PRINCIPLES:

**35, 3, 2, 25, 9, 19, 13, 8, 5**

The solution strategy evolved by the lichen is, on the one hand, Separation (Principle 2) of the fungus and bacteria under certain conditions, and the switching between strategies (Principle 19, Periodic Action) when conditions change. Simple when you know how. Even for symbionts.

### Read More:

Sonia Merinero, Marcos Méndez, Gregorio Aragón, Isabel Martínez. **Variation in the reproductive strategy of a lichenized fungus along a climatic gradient.** *Annals of Botany*, 2017; 120 (1): 63 DOI: [10.1093/aob/mcx045](https://doi.org/10.1093/aob/mcx045)

## Short Thort

*“Nothing was ever in tune. People just blindly grabbed at whatever there was: communism, health foods, zen, surfing, ballet, hypnotism, group encounters, orgies, biking, herbs, Catholicism, weight-lifting, travel, withdrawal, vegetarianism, India, painting, writing, sculpting, composing, conducting, backpacking, yoga, copulating, gambling, drinking, hanging around, frozen yogurt, Beethoven, Back, Buddha, Christ, TM, H, carrot juice, suicide, handmade suits, jet travel, New York City, and then it all evaporated and fell apart. People had to find things to do while waiting to die. I guess it was nice to have a choice.”*

Charles Bukowski, Women



*“The problem, often not discovered until late in life, is that when you look for things in life like love, meaning, motivation, it implies they are sitting behind a tree or under a rock. The most successful people in life recognize, that in life they create their own love, they manufacture their own meaning, they generate their own motivation. For me, I am driven by two main philosophies, know more today about the world than I knew yesterday. And lessen the suffering of others. You'd be surprised how far that gets you.”*

Neil deGrasse Tyson

## News

### Australia

After what feels like a very long gap, it looks like we'll be back in Australia a couple of times in the first quarter of 2018. Sydney and Melbourne are looking like the two main destinations, and most of the available days are already committed, but if anyone is interested in doing something with Darrell during one of the trips, please get in touch to see if something can be arranged...

### India

...the same goes for India, which also looks like being the destination for two trips in Q1 next year. Mumbai and Bangalore are 'definites'; Chennai is a strong possibility.

### ICDC Conference

Darrell's keynote at the International Conference on Design Creativity event in Bath, 'Conscious Creativity: Don't Just Do Something, Stand There' will take place at 1330 on Friday 2 February. Register at the conference here: <http://www.icdc2018.org.uk/>

## **HOSI 3<sup>rd</sup> Edition**

Chugging along in the background through 2017 has been work on the next edition of the technical version of Hands-On Systematic Innovation. It finally looks like the end of the journey is nigh and so we're looking for testimonials from readers to feature at the beginning of the new book. Any and all contributions gratefully received.

## **New Projects**

This month's new projects from around the Network:

- FMCG – Patent 'Invent Beyond' Study
- Apparel – Design-Thinking-&-TRIZ Workshops
- Automotive – SI Mentoring Programme
- Security – SI Certification Workshops
- Retail – SI Certification Workshops
- Transport – SI Problem-Solving Workshops
- Utility – Technology Transfer Project
- Government – Innovation Strategy Workshops
- Government – Smart-City Solutions Project
- FMCG – PanSensic Consumer Insight Study

## **2017 – That Was The Year That Was**

Well, from a 'finishing books' perspective, 2017 was an unmitigated disaster. From a 'doing meaningful work with clients' perspective, it was probably our best ever year. As we head into the holiday season here in the UK, the SI team would like to take this opportunity to wish all of our readers, clients and provocateurs a restful break and a prosperous and enjoyable 2018.... It's a dangerous (krypto-tulip) world out there, take care everyone.