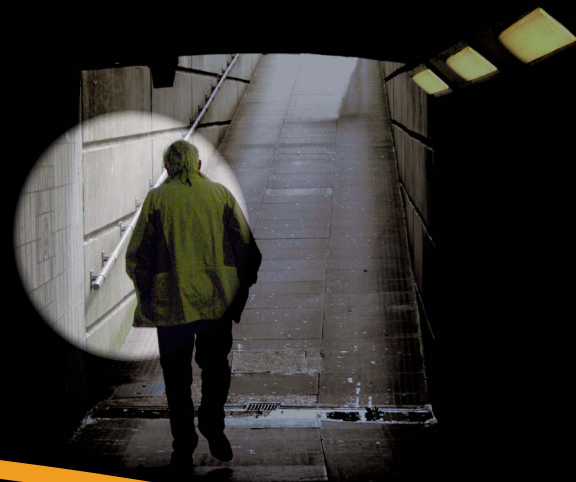


# Want to see what **we** see?

## Enhancing Visibility in Real-time!



### The technology

It is called LYYN (V.E.T.) Visibility Enhancement Technology. Visibility is enhanced in **real-time** in fog, dust, lowlight, snow, smoke, subsea, etc.

LYYN works on images and video from normal color cameras, but can also be used in processing saved material.

### Imagine the possibilities.

The pictures below are just still pictures that we have enhanced. The true power of LYYN is that this can be done in **real-time** in a live video stream, digital or analogue. This could have been the feed from a surveillance camera in a video security system. Air traffic control, for instance, would have a better view of the airfield. They might even see that a plane is going down the wrong way in the fog...

### It is not magic.

It is mathematics, based on the knowledge of how the human brain interpret information from the eyes.

### Low cost.

As LYYN can be integrated into existing systems as a "turbo charger", no expensive upgrade of complete systems is required.

### LYYN at a glance

LYYN is a Swedish image technology company situated in Lund. All products are developed and manufactured locally.

Based on many years of research in the human vision system and imaging technologies the company was formed in 2003.

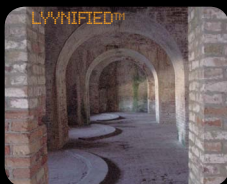
LYYN operates globally through distributors, dealers, system integrators and product manufacturers in more than 30 countries. Also, more than 20 LYYN Inside™ customers offers products with LYYN fully integrated.



FOG & HAZE – LYYN gives you a clearer vision



DUST – LYYN gives you a clearer vision



LOW LIGHT – LYYN gives you a clearer vision



SNOW – LYYN gives you a clearer vision



SMOKE – LYYN gives you a clearer vision



SUB SEA – LYYN gives you a clearer vision

# Pushing the limits of underwater video

By Fredrik Beckman  
LYYN AB

## Pushing the limits of underwater video

The key to successful underwater vision is getting rid of the water! This cliché is as old as underwater photography itself, but it's still true today. Depth, distance, lighting, turbidity of the water, salinity, and pollution all contribute to the visibility, and the perception of size, shape, and color of underwater objects. Adding the abilities and limitations of the human eye and brain makes this a very challenging environment. However, technological development is rapidly pushing the limits of what we can see and do underwater.

## Water vs. air

Water is 800 times denser than air. When light enters water, it interacts with the water molecules and particles, resulting in loss of light intensity, color changes, diffusion, loss of contrast and other effects. If you take an underwater photo of an object one meter away, it will be similar to a photo above water at 800 meters; both will look bluish and lack contrast.

## Light under water

Sunlight is reflected by the surface of the water, which causes significant changes in visibility and the perception of color underwater. Depending on the waves light may form patterns or become randomly diffused. The amount of light reflected also depends on the geographical location, the time of day, weather conditions, the season and the condition of the sea.



ROV inspection of a pipeline in highly turbid water where the center of the image has been lynnified

If you descend more than a couple of meters you will need to bring your own light source. Unfortunately, lamps tend to have a 'hot spot', resulting in an image with a very bright center becoming darker towards the edges. In turbid waters a camera sensor will be almost blinded by the reflections at the center while the edges appear very dark. So the ideal camera should have a highly dynamic low-light sensor reducing the need for high-power illumination. Or – you could use electronic video enhancement technology like lynnification™ from LYYN®.

## Color under water

An important part of vision underwater is being able to distinguish different colors, or actually specific wavelengths of light being reflected off objects and picked up by the eye or the camera sensor. Different wavelengths are absorbed differently as the light passes through the water. The shorter the wavelength, the deeper (longer) it will reach before being absorbed. This causes objects to lose their color as you go deeper down or further away.

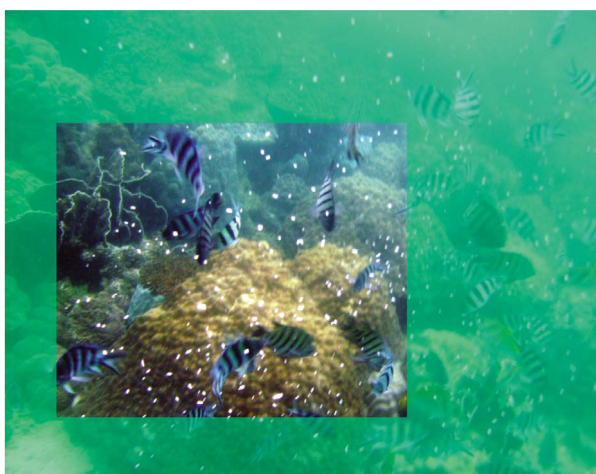
Estimated visibility in clear water		
Color	Wavelength (nm)	Depth (meters)
Red	780 - 622	5
Orange	622 - 597	10
Yellow	597 - 577	20
Green	577 - 492	30
Blue	492 - 455	60

Source: Webster, M.,  
*Art and Technique of Underwater Photography* (1998)

Weeds, rocks, animals and manmade objects generally appear to have the same color as the depth or viewing range increases. Objects become distinguishable only by differences in brightness and not color. Contrast becomes the most important factor in visibility, and even very large objects may be undetectable if their brightness is similar to that of the background.

Water depth is not the only factor affecting the filtering of colors. Salinity, turbidity, the size of suspended particles, and pollution all affect the color-filtering properties of water. For instance, plankton absorbs purples and blues. So the presence of plankton would cause blue and purple objects to lose their colors much faster than red and yellow objects.

Humans on-site can make some adjustment, psychological in part, which allows divers to perceive some of the warm colors of the coral reef. But camera sensors have no ability to compensate for the blue/green filtering of sea



Part of the image lynnified, bringing out the beauty of the reef



water. This is why the fantastic colors of the reef appear cold and lifeless when you look at your holiday photos or videos at home.

### Turbidity and contrast

Bright particles in water reflect and scatter light, resulting in diffusion. Sometimes, diffusion is helpful because it sheds light on areas that would otherwise be in shadow. Normally, however, diffusion interferes with vision because the backscattering reduces the contrast between an object and its surroundings.

The loss of contrast resulting from diffusion and loss of color spectrum are the major reasons why vision underwater is so much more restricted than it is on land.

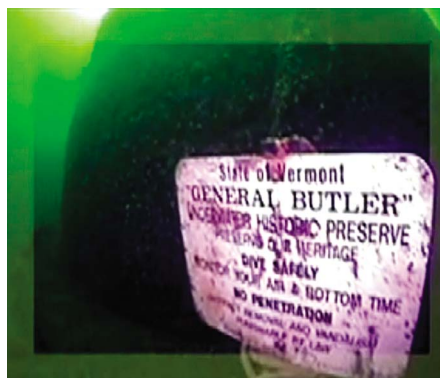


*Corrosion found on an azimuth thruster.*

### LYYN in underwater archeology

Rachael Miller is running a successful tour operation in Lake Champlain, Vermont. Though only the sixth largest of America's lakes, Lake Champlain's distinction is what it contains, arguably, the nation's largest collection of historic wooden shipwrecks.

Rachel uses a VideoRay ROV to explore the historical shipwrecks where muddy waters are a problem. Passengers on the boat can now see the ship's cleats and windlass.



*"Welcome to the General Butler. Please dive safely. Don't penetrate the wreck!"*

"It's really fantastic!" says Rachel. "Visibility in Lake Champlain can be really difficult. There are even days when the turbidity's so bad we have to cancel the tours. Now my clients can see what's down there and get full value for money, whatever the visibility conditions."

### LYYN in underwater inspection

SeaVision Marine Services LLC, located in Connecticut, recently completed two UWILD (Underwater Inspection in Lieu of Drydocking) inspections on vessels operated by one of the major offshore support vessel companies in the Gulf of Mexico that are homeported in the brown waters of Port Fourchon. They used two inspection class ROVs from SeaBotix equipped with integrated LYYN HAWK™ video enhancer boards.

"The LYYN visibility enhancement was critical to the overall performance. Even after traveling thirty miles offshore we only had about 5 to 8 feet of visibility, but the LYYN unit really helped to clear up the imagery" says Jeffrey Z. Snyder, president of SeaVision Marine Services LLC.

### Piloting a submersible with LYYN

The Institute of Oceanology's research submersible PC-8 has been in operation since 1987. The submersible has been used in many operations; one of the most publicly known is the series of expeditions to the Black Sea initiated by National Geographic Society's Robert Ballard, the oceanographer and undersea explorer famous for his discovery of the Titanic and other historic shipwrecks.



*The PC-8 submersible*

"In our case, when the UW visibility decreases I start piloting the submersible watching the TV monitor showing the LYYN T38™ enhanced video and stop looking through the front window..." says Dr. Iliya Shtirkov, engineer at The Institute of Oceanology, Varna, Bulgaria.

For more about these cases and others, including video samples, visit [www.lyynified.com](http://www.lyynified.com).

For more information about LYYN and LYYN products, visit [www.lyyn.com](http://www.lyyn.com).



*The center part is lyynified, clearly showing the details of a wreck*

Underwater photographers have been battling with these problems since the early days. One can use different filters to try to compensate for the loss of a particular wavelength, or the white-balancing feature on video cameras that tries to compensate for the color cast. But all these traditional methods are very crude with severe limitations.

### LYYN technology

The revolutionary method of lynnification™ takes a different approach. Each video frame is optimized for contrast and color spectrum to make it as "natural" as possible to the human eye. Even the smallest fragments of color and object shape can be extracted from the camera sensor to restore the scene as much as possible. And all this is done in real-time. The result is an image that constantly self-adjusts to the environment, and the diver or ROV pilot can focus on mission objectives.

### 350 users

More than 350 users have gained better visibility with LYYN products. Meet three of them:

# Want to see what **we** see?

## Enhancing Visibility in Real-time!



### Murky water? Any water!

In any situation where you need to see clearly under water, you need LYYN and its unique Visibility Enhancement Technology. In fact, using LYYN will always give you a clearer vision in subsea!

### Imagine the possibilities.

The pictures below are just still pictures that we have enhanced. The true power of LYYN is that this can be done in **real-time** in a live video stream. This could have been the feed from the camera from an ROV. Imagine what this means to the 350+ LYYN users in their underwater activities. You find them in underwater inspection, security and salvage operations, archeology and marine biology. Inshore and offshore!

Visit [www.lyyn.com](http://www.lyyn.com) for more information! Don't miss the showroom where LYYN users share their lynnified videos.



Murky waters or low light – LYYN always gives you a clearer vision.

### Portable or integrated into your system.

Whatever the situation, there is always an option for your need to get a clearer vision – for individual use or integrated into equipment or even a whole CCTV system.



### LYYN T38™

LYYN T38 is the portable solution to your visibility problems in subsea. It is easy to use. Connect it in-between the camera and a monitor or a video recorder. The screen will show enhanced visibility real-time, helping you to focus on your mission objectives, completing your task faster and with higher quality.



### LYYN Hawk System™

LYYN Hawk System is a 19" rack mounted visibility enhancer. This is the real-time lynnification solution for analog CCTV systems. By installing it with a video switch it is possible to lynnify a whole system. You only need one LYYN Hawk System per simultaneous viewing channel. The operator can choose and switch any camera through the unit, providing lynnification wherever it is needed.

### LYYN Inside™

LYYN also provides integration solutions to subsea equipment manufacturers, including most major inspection class ROV manufacturers. Just ask, and you will find LYYN on their accessory list.

