NANOVEA

FISH SCALE SURFACE ANALYSIS

USING 3D OPTICAL PROFILER

Prepared by

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INTRODUCTION

The morphology, patterns, and other features of a fish scale are studied using the ***NANOVEA*** 3D Non-Contact Optical Profiler. The delicate nature of this biological sample along with its very small and high angled grooves also highlights the importance of the profiler's non-contact technique. The grooves on the scale are called circuli, and can be studied to estimate the age of the fish, and even distinguish periods of different rates of growth, similar to the rings of a tree. This is very important information for the management of wild fish populations in order to prevent overfishing.

IMPORTANCE OF 3D NON-CONTACT PROFILOMETRY FOR BIOLOGICAL STUDIES

Unlike other techniques such as touch probes or interferometry, the 3D Non-Contact Optical Profiler, using axial chromatism, can measure nearly any surface. Sample sizes can vary widely due to open staging and there is no sample preparation needed. Nano through macro range features are obtained during a surface profile measurement with zero influence from sample reflectivity or absorption. The instrument provides an advanced ability to measure high surface angles with no software manipulation of the results. Any material can be easily measured, whether it's transparent, opaque, specular, diffusive, polished or rough. The technique provides an ideal, broad and user friendly capability to maximize surface studies along with the benefits of combined 2D & 3D capabilities.

MEASUREMENT OBJECTIVE

*In this application, we showcase **NANOVEA** ST400, a 3D Non-Contact Optical Profiler with a high-speed sensor, providing comprehensive analysis of the surface of a scale.*

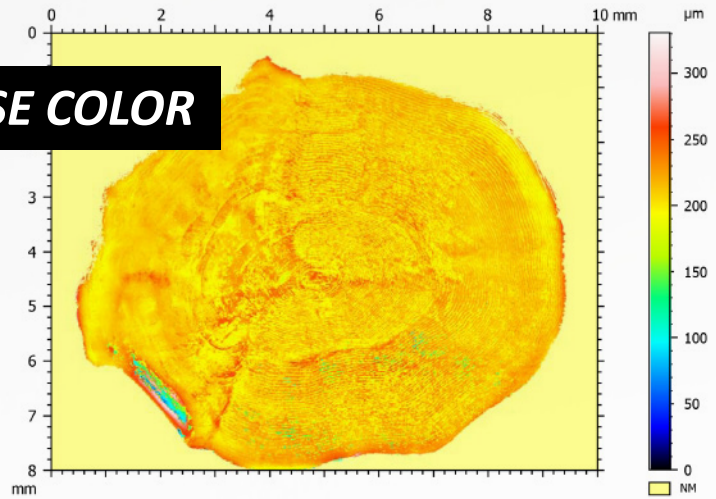
The instrument has been used to scan the entire sample, along with a higher resolution scan of the center area. The outer and inner side surface roughness of the scale was measured for comparison as well.

NANOVEA
ST400

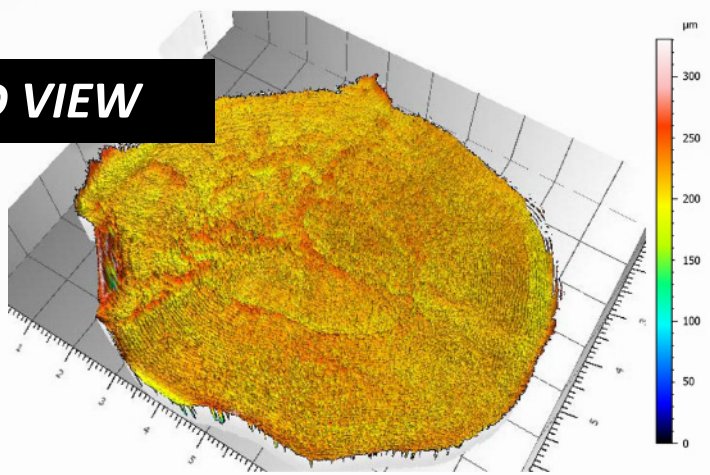
3D & 2D SURFACE CHARACTERIZATION OF OUTER SCALE

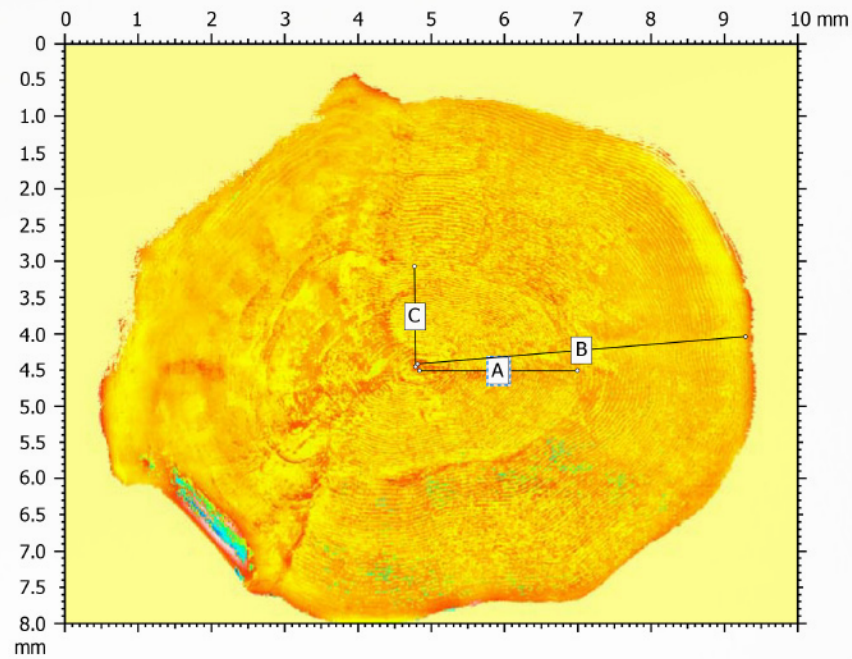
The 3D View and False Color View of the outer scale show a complex structure similar to a finger print or the rings of a tree. This provides users a straightforward tool to directly observe the surface characterization of the scale from different angles. Various other measurements of the outer scale are shown along with the comparison of the outer and inner side of the scale.

FALSE COLOR



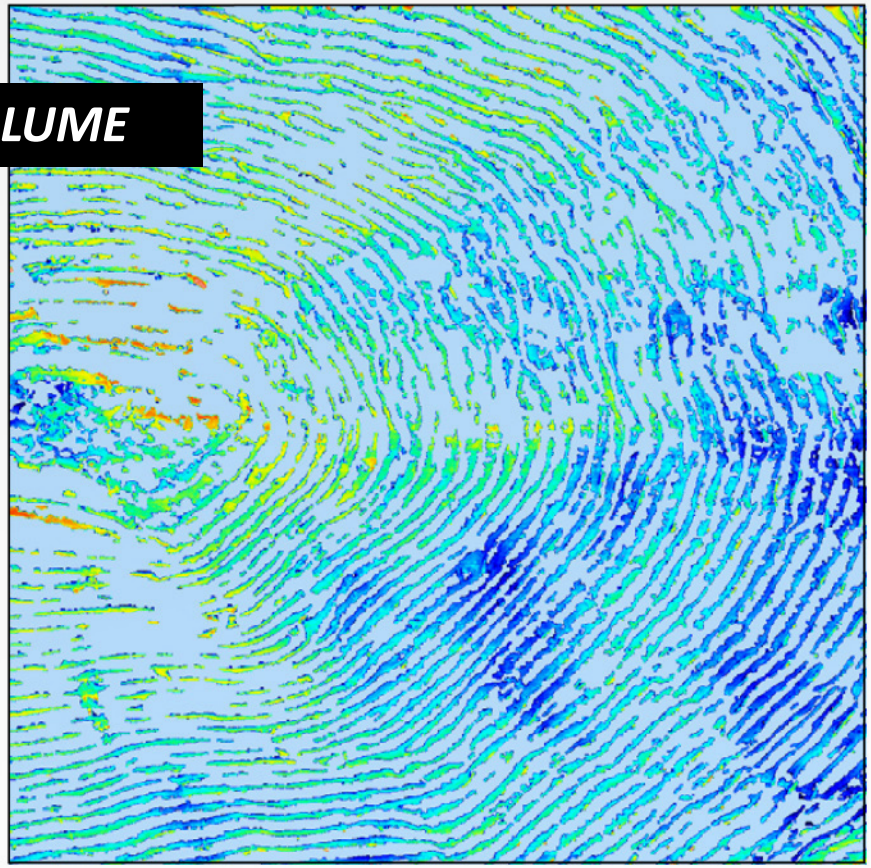
3D VIEW





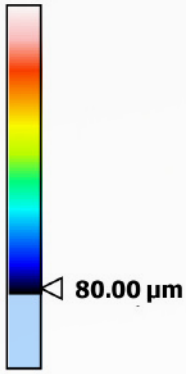
Distances	Unit	A	B	C
HDist	mm	2.156	4.490	1.387

VOLUME

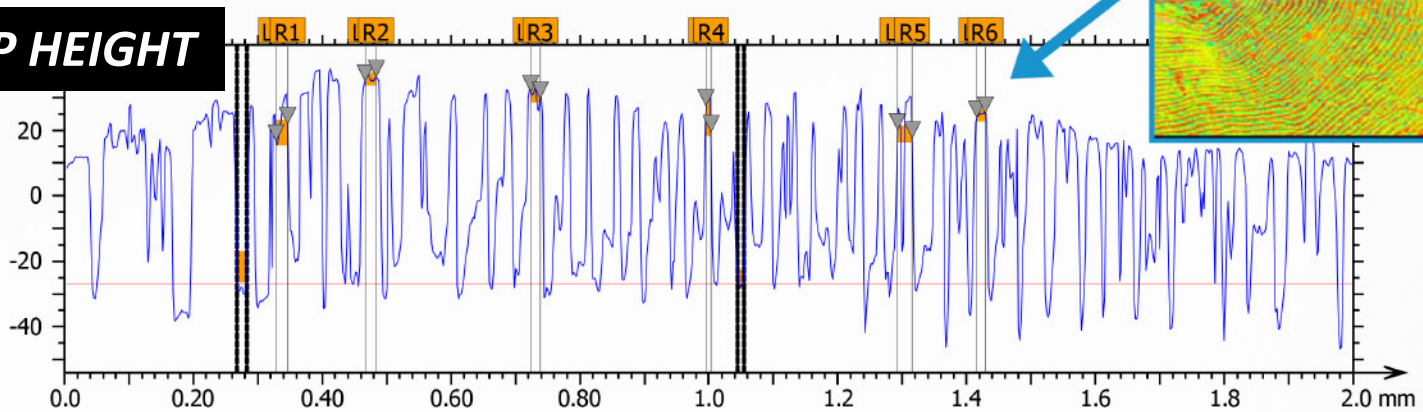


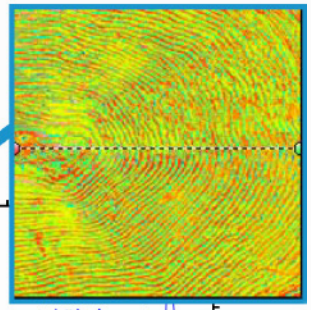
Number of islands	705
Threshold	80.00 µm

Parameters	Stat.	Value	Unit
Area	Mean	0.001736	mm²
Perimeter	Mean	365.3	µm
Orientation	Mean	97.43	°
Volume	Mean	28047	µm³
Max height	Mean	26.06	µm



STEP HEIGHT

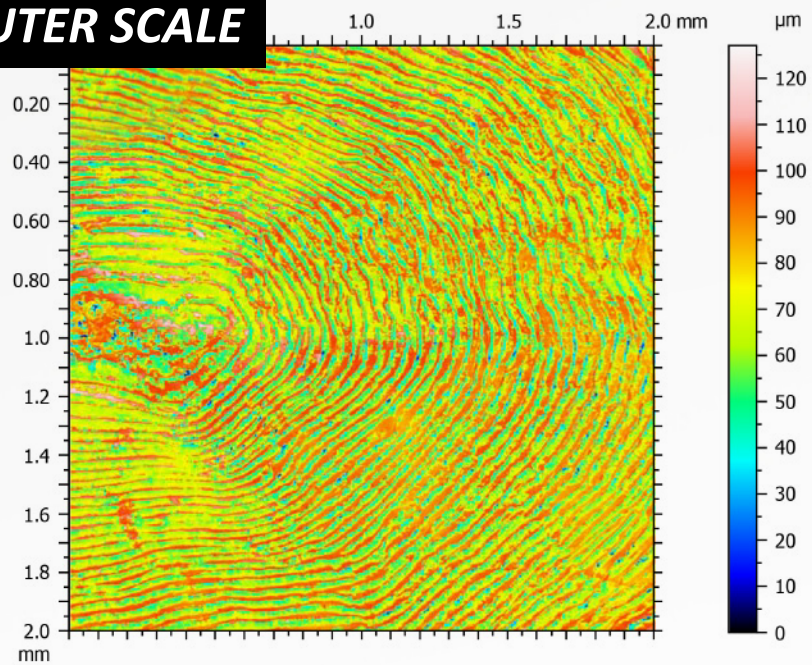




Parameters	Unit	Step 1	Step 2	Step 3	Step 4	Step 5	Step 6
Maximum height	µm	57.91	63.46	59.96	57.24	57.05	52.12

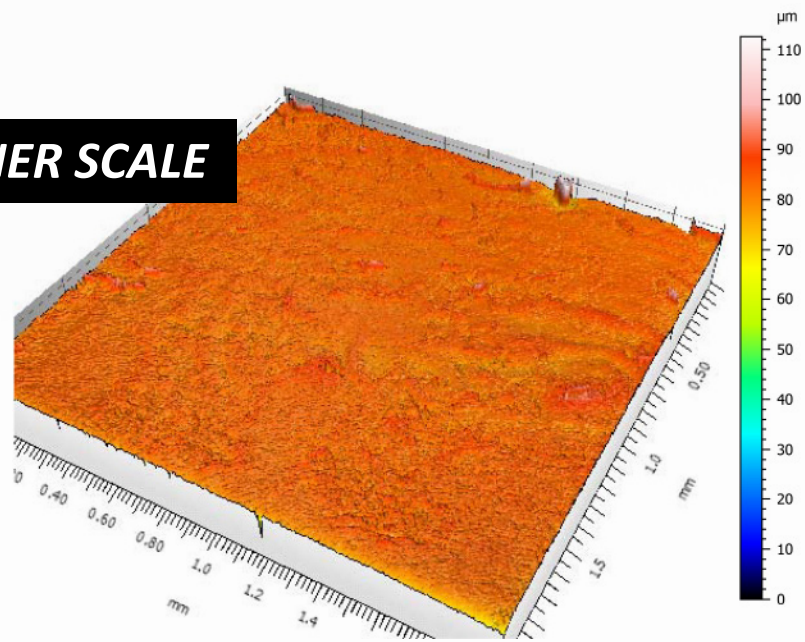
SURFACE ROUGHNESS COMPARISON

OUTER SCALE



ISO 25178		
Height Parameters		
Sa	15.92	µm
Sq	18.43	µm
Sp	52.78	µm
Sv	74.28	µm
Sz	127.1	µm
Ssk	-0.09082	
Sku	2.143	
Other 3D Parame...		
Miscellaneous		
Spar	4.000	mm²
Sdar	18.06	mm²

INNER SCALE



ISO 25178		
Height Parameters		
Sa	1.552	µm
Sq	3.393	µm
Sp	29.54	µm
Sv	83.12	µm
Sz	112.7	µm
Ssk	-10.03	
Sku	207.1	
Other 3D Parame...		
Miscellaneous		
Spar	4.000	mm²
Sdar	4.859	mm²

CONCLUSION

In this application, we have shown how the ***NANOVEA*** 3D Non-Contact Optical Profiler can characterize a fish scale in a variety of ways.

The outer and inner surfaces of the scale can be easily distinguished by surface roughness alone, with roughness values of 15.92µm and 1.56µm respectively. Additionally, precise and accurate information can be learned about a fish scale by analyzing the grooves, or circuli, on the outer surface of the scale. The distance of bands of circuli from the center focus were measured, and the height of the circuli were also found to be approximately 58µm high on average.

The data shown here represents only a portion of the calculations available in the analysis software.