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ON-CHIP LASER PROBE FABRICATION FOR TRACE AND CROSS TRIGGERED SCANNING (T&CTS) IN OPTICAL MICROSCOPY

N. Z. AZEEMI[†], NAJAM-US-SAQUIB[††], IFTIKHAR AHMED

[†]IEEE Council Member Smart Cities Management, School of Research and Graduate Studies, Al Dar University College, Dubai, UAE, [††]Ministry of National Health Services, Regulation & Coordination, Government of Pakistan, System Integration Labs Nokia, Tampere, Finland,

E-mail: naeem@aldar.ac.ae, najam2pk@yahoo.com, i.ahmed@nokia.com

ABSTRACT

Unlike Chemical Force Microscopy (CFM), non-invasive instrumentation provides nondestructive, reliable and precise control in industrial process regulation, where a chemical compound or material surface are always a point-of-care. Nanomaterial dynamics intrinsically exhibit higher order of visual scanning complexities, associate wholly or partially to the poor scanning instrumentations. Additionally, growing trends in analytical instrumentation towards smart Lab-On-a-Chip (IoT sensing nodes) has shifted the emphasis on sensitivity as well as robustness tailoring Product Specific Environment (PSE). This work presents a hybrid laser actuated scanning mechanism, rastered back and forth 3-D imaging technique enabling Microscopy to its widest application in biological and material sciences and hence rose challenge of predicting large missing or incorrect data obtained during experiments.

Our Confocal Self Calibrated Interferometry based fabricated Laser Sensor demonstrate its efficacy in non-invasive scanning microscopy to achieve high resolution 3D topographical view, eventually an add-on to analytical model of micro-organisms and nanomaterial. The laser leakage at tip is controlled by PI controllers based on two channel tube adjustments and successively in laser reflector lens, Photo Multiplier Tube (PMT), and Data Acquisition Unit (DAU). We exploit the dead time transfer function characteristics to simplify our model which is an inherent feature of Scanning Luminance Microscopes (SLM) and Scanning Electron Microscopes (SEM). We expose our results for error propagation across various grid patterns over a $1mm^2$ section, plotting the intensity of a key band or bands over the grid. We observe that the spatio-temporal measurements can be preserved modelling the ergodicity of information flow along the SLM instrumentation.

Keywords: *Data Acquisition Unit, Scanning Luminance Microscopes, Ergodicty, Smart Instrumentation, Laser Sensor*

1. INTRODUCTION

Industrial Process Regulation (IPR) are restrained to tightly coupled scrutiny of scientific data and results in regulation of R&D for correct, up to date and conforms to the Regulation Bureau Service (RBS) indicators[1,2], yet make it both eco-friendly to ever increasing demand among smart urban areas. The increase demand for smart instruments put forth additional decision indicators in the Instrument-in-Loop (IiL) to facilitate better Time-to-Deployment (ToD) in a given scenario [2, 3, 4], such as handheld measuring instrument. The important role of working knowledge expert expedite the transformation phase of an analytical model, while a comprehensive history of techniques and off-the-shelf devices augment the ToD. It eventually improve the proto development cycle, both in terms of cost-design time complement with the performance at both deployment and development latencies [5, 6, 7]. The on chip available cores add fast development pace, aligned with comprehensive design space exploration, which otherwise could lead to np-hard unless a rapid proto typing is obtained keeping all artificial intelligence machine learning engines in the development cycle. E.g., Qualcomm, Snapdragon 865 took 3 years to provide unprecedented functionality in bring AI engines, 5G cores, cryptography on one core to support existent Cortex high performance octa cores [8, 9]. But researcher did find its development history associated with Snapdragon 765 already available at

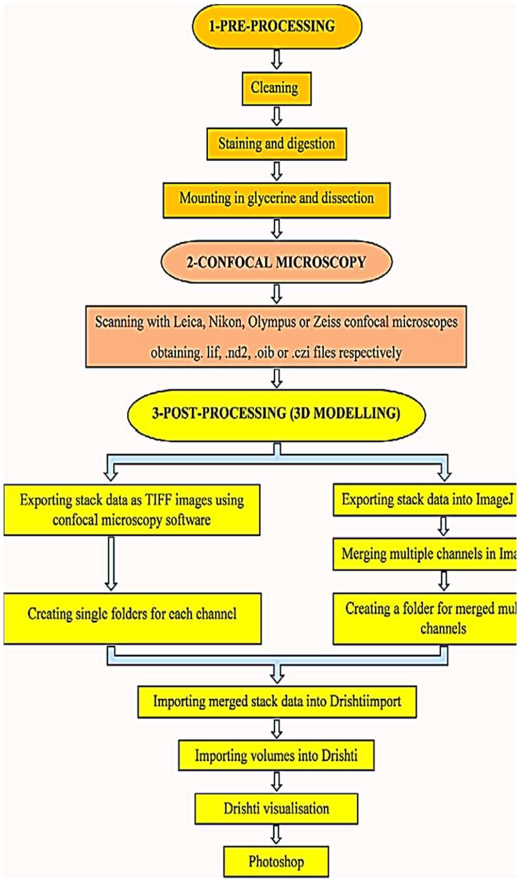

Fig. 1. Simplified Flowchart For Visualization And 3D Topographic Imagining Analytical Industrial Process [2]

various mobile platforms, including handheld instruments. A smart design cycle, later on emerged into squeezing external data traffic onto SD 765, hence named SD 865 [8, 9].

This work brought together refined industrial instrumentation methodologies, tailoring smart industry requirement of the age, i.e., low form factor to accommodate OEM, and high performance speed to meet the data traffic demand as generated in any sensing point on a typical IoT network [10, 11]. We achieved our objective, taking into consideration computing intensive non-linear analytical techniques which add another layer to the key industrial instrumentation. The miniaturization technology to 7nm scale encourage us to tailor the demand in non-invasive instrumentation, which are widely used in scanning of microorganisms both in vitro and ex vitro experiments as well as monitoring [12, 13, 14]. This conforms analytical observation and experience commenced by scientist, researcher or industrial use case lead into the miniaturization, hence termed as Lab-on-Chip (LoC); which not only evaluate comprehensively a specimen with a correct choice of instrumentation in place, but also enable smart IoT devices subject to scenario constraints on an appropriate applications [13, 15, 16]. Readers may find list of acronyms used in presented work at the end of paper in Table I.

We recommend a closed loop decision tier for analytical method development based on three key characters, they are shown in Fig. 1. An analyst is presumed to aware of various available options (as an expert knowledge or enabled with machine learning search engines), which enable them to reach an optimal desired solution in their provided scenario for offered design space [17, 18]. The flexibility of such methodology is inherent in virtualization of deployed technology history, enable a smart choice without compromising on successive learning, and eventually leads to significant reduction in ToD.

A. Non-Invasive Optical Illumination Analytics

The specimen non-pervasive scanning is of common interest especially researcher from diverse background as engineering, information management systems, pure sciences; who are involved in any capacity of analytical modeling from their observed and experimental logs [19]. Therefore analytical methods—scientific development into theory, laws and regulations can be witnessed among the academic profile to industrialists, edible items and their signature analysis, identification of toxic elements broadly addressed by the pharmaceutical industries in special and food drug authorities in general.

The critical per view of an analytical scientific experiment provide multitude of dimension into any empirical model complement a vivid theoretical comprehension in contrast a rigorous hands on laboratory experimental practices tailoring RBS [20, 21, 22]; hence provide reuse on any virtual platforms, as the term coined in IoT network sensing nodes. Each set of design space accessed in a multivariate optimization objectives brings both principles lying over analytical techniques and

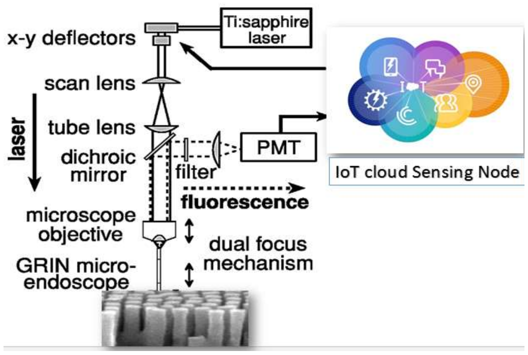

Fig. 2 Functional Viewpoint Of Confocal Microscopy Iot Sensing Node

experimental techniques in a converged asymptote [23].

B. Smart Design and Packaging—an IoT Sensor Node

Our framework reflects the key role of laboratory widely practiced techniques over a wide range of non-invasive scanning scenarios, which is hitherto be explored, especially Machine Learning (ML) enabled engines on chip or off chip. The measurement ranges are often restricted by lack of available analytical techniques which is often an unawareness and distinguishably resolved with off the shelf ML strong mining techniques [8, 9, 10, 24]. We deem an optimal scenario on a typical Pareto wave front subject to optimization and deployment constraints, thus naturally demands Phenomenal Analyses of Interest (PAoI). The turn-in for critically evaluated problem course converges at cost-design time, volume of research team, added magnitude into knock-on attempts, vulnerability to scanning laser, data missing to poor contrast for non-invasive ambient conditions. This work provide additional proficiency to the analytical experts as well as theoretical scientist [25].

The intermediate logical steps in a phenomenal process are illustrated in Fig. 2 for complex specimen exposed to non-invasive laser scanning to quantify the measurement on proposed LoC environment. The flow methodology tackle hidden malpractices by binding strictly with RBS indicators, discouraging thumb rule experiences, adhering effective and reliable pathway. Traditional practices are useful, when offline training is required to achieve a converged objective function to mostly tailoring instrumentation techniques and yet reducing the complexity imposed frequently when non-linear systems are taken into account [26, 27]. The pre-simulation logs for LoC are used to resolve such discrepancies generating both qualitative and quantitative indicators restrained generally for complex specimens as exposed to non-invasive laser actuated instruments [28]. We also presented hybrid techniques complement the analytical approaches, though logical in comprehension yet slow down he convergence to ToD without sacrificing cost-design time constraints [29, 30].

2. MATERIAL AND METHODS

In contrast, Fig. 2 clearly provide a roadmap to a designer in answering following questions:

- Identify the ultimate aim contribute a significant confidence interval to aimed objective?
- The most likely confidence neighborhood to find such solution?
- What is time to converge in meeting a ToD constraints?
- How to generate regulated qualitative indices, in a design space of analytical solutions?
- Which techniques are suitable to satisfy empirical data and close adherence to analytical models?
- What is estimated time to ToD?
- What is cost-design time neighborhood bracket to satisfy non-invasive specimen constraints?

A. Confocal Self Calibrated Interferometery based Laser Sensor (ConLSCI)

The evaluation of aforementioned questions is only done at the critical per view of a laboratory experiment while other factors of expertise, duration, budget and off the shelf components availability is intact. Only an open solution would satisfy on any multivariate constrained objective function, but prone to capture np-hard state or local minima (a non-optimal design parametric scenario).

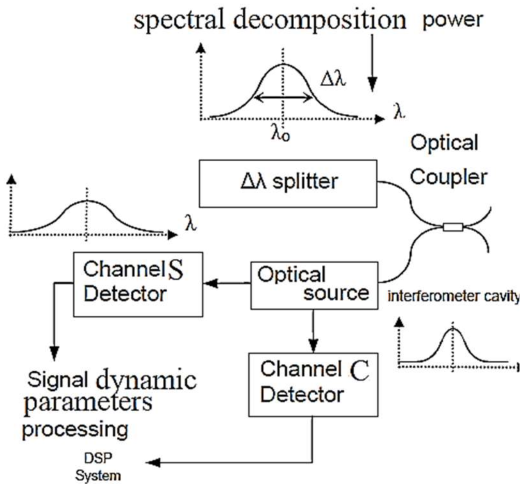

Fig. 3 Simplified View Of Conlsci Sensor In Confocal

Our scenario is strictly a laser actuated non-invasive scanning adhere to LoC accuracy for a mobile environment, suitable to equivalent precision but much faster response depicted in Fig. 3. Such conflicting objectives often lead to less accuracy though zero time field operations, most unlikely in traditional laboratory practices having strong foundation on pedantic methodologies [31].

Smart instruments in any IoT network sensing node are rapid-pace, self-adjustable to perform multiple scanning session in parallel on-demand. Only AI-enabled, fast cores provide such automated measurements, presumed to be self-calibrated over a precise time, due to its visibility to Always Available Always Online (A3O) connectivity at IoT node.

B. Phenomenal Analyses of Interest—The Specimen Constraints

RBS plays a key role in aligning diversity of technologies across the manufacturing process, yielding miniaturization of multi-functional scalability on a single core [32]. The relative approaches are promising to provide an OEM various choices to conform their non-invasive scanning scenarios, but require a robust measurement indicator profile which can only be achieved in calibrating the sensitivity to a specific standard. As long as macro object illuminated specimens are in account, the correct geometrical feature extraction is close to the actual specimen, but that is hard to achieve for micro-organisms, hence give rise to intense need for generic measuring resolution standards, especially in the wider deployment across the geographically spread labs and mobile profiles, to name a few. The relative error of measurement is a precursor to questions raised on finding 'an optimal' techniques to satisfy both analytical and empirical neighbourhood of confidence, as raised in 'what type of methodology to choose?' A wider range of aforementioned sensitivities, correct, robust and precise measurement can only referenced when the frequency, analysis speed instantiation for a laser exposed specimen has almost closer numbers for LoC either in a laboratory environment, remotely operated units or handheld IoT hubs. While keeping considerable grace to prohibition on the per specimen recurring cost, the accuracy of result cannot be ignored at all, especially while an epidemic is monitored in non-favourable field situations. Where concentration range of specimen arise to a significantly higher number, but yet need to be addressed when look at a large canvass for geographical spread such as CovId19 now a days [33, 34]

The relative error of measurement is a precursor to questions raised on finding 'an optimal' techniques to satisfy both analytical and empirical neighbourhood of confidence, as raised in 'what type of methodology to choose?' Here the accumulative factors of interest leads to a concentrated design, which practically work across the scientist to reproduce and verify relative findings to both selective as well as specific ambient conditions. A wider range of aforementioned sensitivities, correct, robust and precise measurement can only referenced when the frequency, analysis speed instantiation for a laser exposed specimen has almost closer numbers for LoC either in a laboratory environment, remotely operated units or handheld IoT hubs. Where concentration range of specimen arise to a significantly higher number, but yet need to be addressed when look at a large canvass for geographical spread such as CovId19 now a days [34, 35].

C. Laser Sensor Fabrication Profile

The pivot role of RBS in aligning diversity of technologies across the labor-centric capita, the automatic well integrated instrumentation cost per specimen though is heavy, but economically feasible when recurring over a long duration of field testing. The notion of 'automatic and well integrated testing

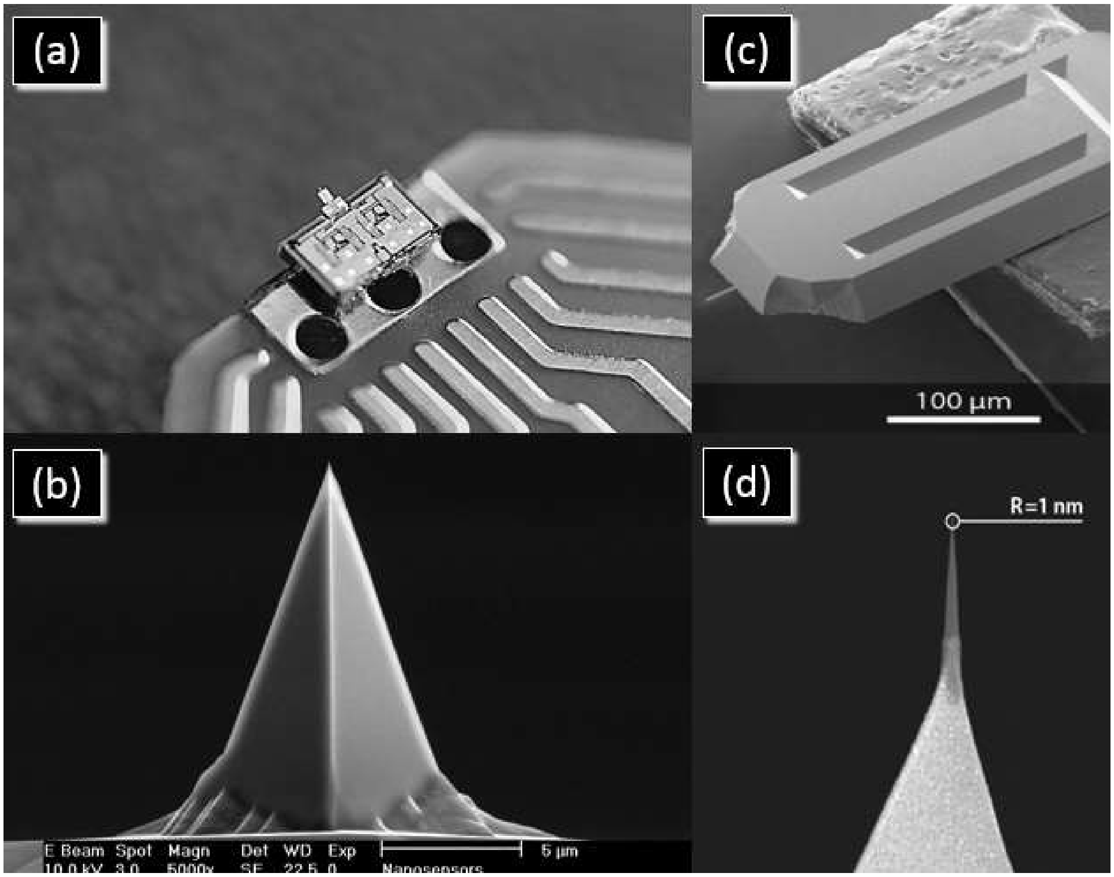

Fig. 4. Laser Tip Profile For High Resolution And Extra Reinforcement Hollow Tube. (A). Single MEMS Chip Coarse Apart Augment Sub-Angstrom Accuracy At Lowest Light Leakage (B). Highly Resonant, Reflex Coating Compliment The Plug And Fit Alignment (C). Tetrahedral Tip At The End Of Cantilever For Accurate ROI On The Specimen (D). At The Gold Coated Silicon Etched Probe, Resistive To Reflectivity In Air Well Defined Extra Tip Of Carbon Spike Diamond

environment' provides significant aid to the analytical model development later in labs and marking disease geography in affected areas [35, 36]. Analytical capability embedded in the IoT hubs, brings a computational power with huge over the cloud storage assist composition of specimen characterization, element of interest sifting, required ambient conditions, and non-invasive work out.

There are four parts of non-invasive scanning devices largely found in analytical laboratories. They are: Function generator, illumination source, the sensor part, analytical part. A unified division of these parts become challenging when it spread across the material engineering, chemical engineering, molecular biology, pharmacokinetics, or other pure sciences. In a broader perspective these discrete functional elements would be: source, specimen, illuminator, sensor, and output [37, 38].

Unified description of instruments. This proposes that analytical instruments are comprised of five distinct modules: 1.Source 2. Sample, 3. Discriminator, 4. Detector 5. Output device. We aim Confocal Self Calibrated Interferometry based Laser Sensor (ConLSCI) to enable IoT maneuverability at any reasonably adjusted scenario. In order to let our approach to render its objectivity, one must have prior knowledge about the proper illuminating laser, various types of detectors and projected output films or media. The accumulative interaction of radiation and specimen produce a series of compound observations revealing the type, quality, magnitude, volume, and quantity that is yielding a precise structure, later termed as analytical model. The multiple layer detectors produce a separate scan plane to render the specimen identity, nomenclature, structural details and activity at micro-organism scale. The compound observations contain a significantly higher precision of structural illumination produce in conjunction with multiple sets of detectors.

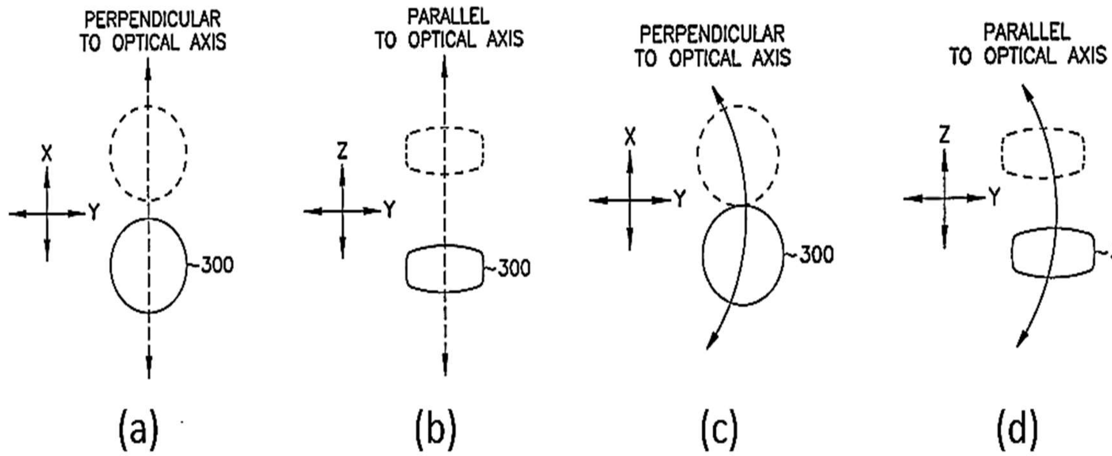

Fig. 5 Fabry-Prerot Cavity Impact On 3-D Coherence Of Reference Channel. A), C) Are Orthogonal Projection To Illuminated Axis, B), D) Are Parallel To Optical Or Illuminated Axis.

Section followed, elaborates detection, evaluation, surface elucidation on a molecular scale concentration on spectroscopic instruments in general and ConLSCI specifically.

D. Design and Fabrication

1) Instrumentation Development and Structure

Applications for light microscopy exist mainly in the biological arena. The material engineering has brought forth another dimension to Nano scale examination of the surface structure in a specimen of materials [39, 40]. They are widely used in compound analysis to distinguish lattice structures or eroding effects where flow of information such as digital data is the traffic, e.g. electrode or chip surfaces that have been coated, to name a few.

2) Confocal Spectrum Measurement

We broke down the confocal microscopy in term of functional viewpoint to extract qualitative features as depicted in Fig. 5. a typical set of features distinguish qualitatively the topography i.e., geometry of surface of object and apparent chromatic contours, morphological attributes which comprehend the magnitude, volume and pattern of nano objects or atoms composing the subject itself and elemental proportion (a well maintained integrated lattice structure defined quantitative distribution of various constituents elements). The set of qualitative and quantitative information is obtained on nano scale of laser illumination, where specimen observation remains non-invasive to maintain presumptuously integrity of specimen geometry as well as life.

Quantitative information may be possible using counting methods based on grids. The depth of visualization is 3 dimensional and high contrast over greater DPIs resolution recorded non-destructively at the confocal microscopes equipped with laser non-invasive scanning for the distinguished regular patterns in cells or tissues. Thick specimens are usually hard to image due to blurring, required an aggressive depth field control (at various orthogonal axis) with multiple sessions at the optics zone of detector and illumination. Our ConLSCI breakdown the successive microscopy session in confocal to achieve high contrast three dimensional images with high resolution obtained mostly depth field control along the perpendicular and parallel optical axis thus reduce the inherent fading or turbulent noise which may be an outcome of equipment vibration or specimen instability without compromising on laser source stabilized platform. ConLSCI confocal iterates various segmentation to draw clear planes among multi-dimensional reasonably solid specimen of tissues or cells.

The laser scanning on LoC rendering are completely nondestructive in nature to the structural

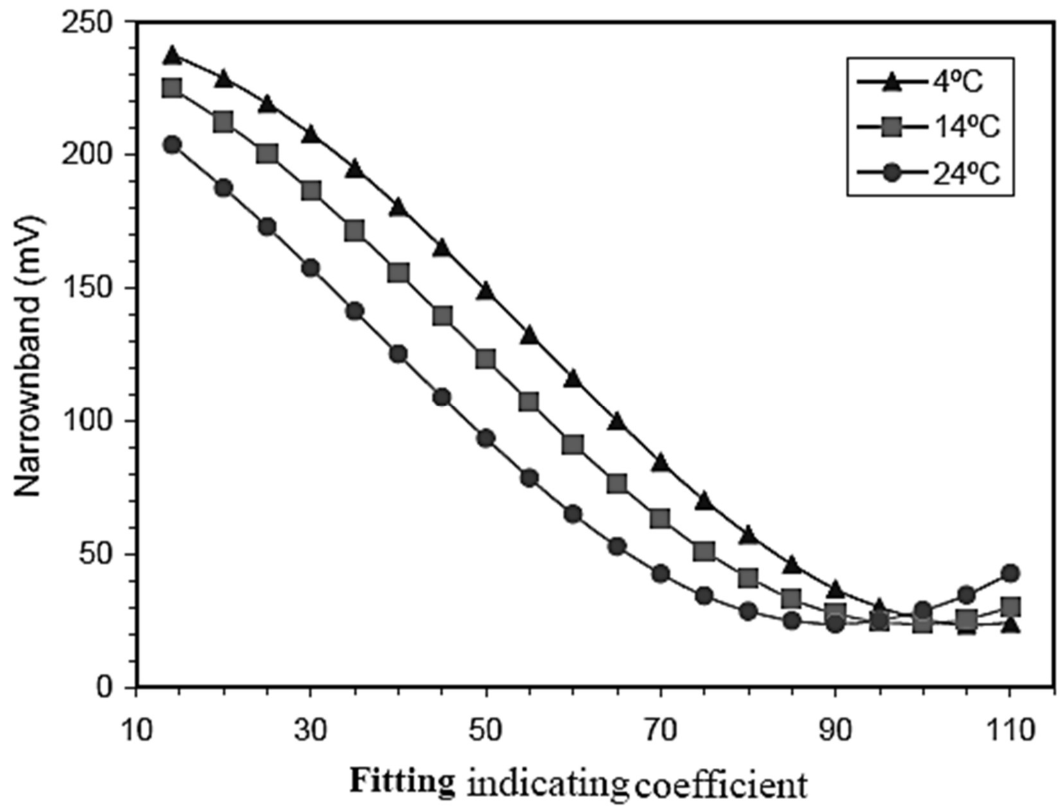

Fig. 6 Robustness Testing Conlsci Sensor At Narrowband Signals Over Three Temperature Ranges

or chemical hazards may be induced when invasive techniques are deployed. Thick objects are viewed as successive recorded thin planes of laser imaging, hence keep the integrity of underlying specimen intact. Multi-plane images are align with the clear objective of confocal microscopy in a contrast enhanced specimen where fluorescent is of particular interest to mark the unknown patterns at higher resolution which reveals the desired features for a particular patterns. Fluorescent techniques in our laser actuated framework not only extract the thin natural patterns, but also derivatively approach to conform a desired analytical model. The process is augmented to accommodate ultra violet illumination spectrum in a microscopy wherever two-photon instrumentation is adapted. The living cells, tissues, surface or skins and diverse biological specimens needs a deeper fined grained resolution by deep illuminated and detector stages.

3) Instrumentation Development and Structure

To meet the requirement of high resolution and high SNR, a high power source is of great importance. The laser light source used in the system is a 1550 nm edge-emitting LED (E2LED) which can launch a maximum power of 50~60 µW into its single-mode fiber pigtail.

Other optical components are thus required to work at 1550 nm. Fig. 5 is the I-P characteristic and Fig. 5 (b) and (d) is the response of the LED, both at 25°C. The most important parameters of the E2LED are its output power and the Central Wavelength (CWL). The output power is essential to the system resolution and should be as high as possible. The CWL will, when the light signal passes through the in-line filter (1551 nm CWDM filter), determine the narrowband signal intensity.

We observe that when the CWL matches the pass band (1551 nm) of the in-line filter, the same variation will introduce smaller error than when there is a mismatch. Therefore the CWL should be around 1551 nm. These two parameters change with temperature and driving current. The schematic of laser pathway is derived in terms of standard instrumentation nomenclature to meet the requirement of off-the-shelf component availability, as follows:

Source

Laser illumination is the source in the confocal microscope, where different resolution of planes are subject to specimen, which is close to the objective lens.

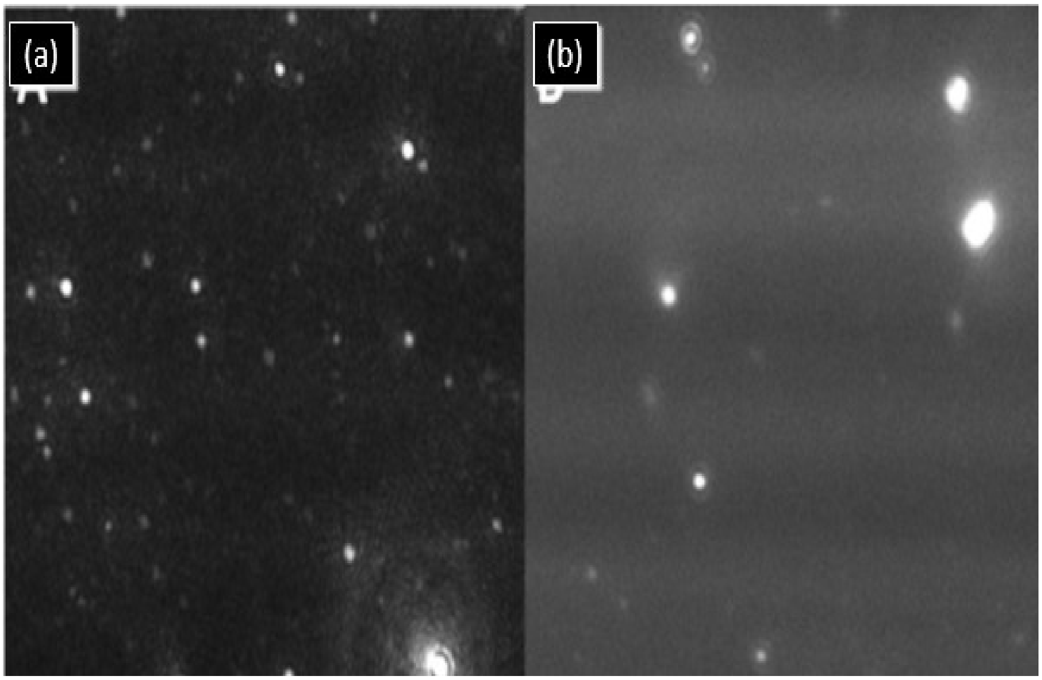

Fig. 7 Complex Nanocarriers Spectrum Visualization For Laser Tip Leakage In (A) Scattering Ambient Light (B) Scattering Fluorescent Segmentation.

Sample

Mounted slides hold the required sample of specimen, which is closer to the stage.

Discriminator

The intermediary planes of high resolution images are detected by the laser illuminator tubes which multiply the photons to achieve higher intensity discrimination, readily distinguished in an analytical model. Discrimination is set on the primary lens, also called objective lens, whereas the detector is attached on the photo multiplier tubes.

Detector

Photo multiplier tubes are the major player in detection phase which record a multi plane high resolution image with or without fluorescent derivatives to provide additional magnification at the EDA tools available on computer.

Output

The manipulation of image formats among various compression or simply a raw image are readily available to standard computer display, where various tools can be deployed to highlight specific matter of interest, while taking into account the analytical models of known surface and structures of known cells or tissues from a database.

3. RESULTS AND DISCUSSION

The physical structure is key to the ConLSCI sensor, which make it suitable for an IP based sensor network, IoT to name it, both for laboratory desktop or portable instruments. The configuration of sensor in proposed ConLSCI are controlled by two orthogonally placed couplers, usually made of optical fiber later transmit to successive range of sensor cascaded to achieve desired resolution optically. We are not considering any digital zooming at this stage, as they are mainly lossy in nature and can be neutralized when engaged on the desktop PCs. In this manner source light illuminate laser actuated recording to cascade set of sensors. A specific gap is maintained between the fiber at input stage close to objective lens and ongoing reflectors. A hollow photon multiplier glass tube provides thermally fused onset to maintain aforementioned gap, hence flexible to planes of input fiber and its cascade fused reflectors. Capillary tubes are thermally fused in the fiber glass to maintain predetermined gaps, which is not achievable for hard adhesive material, as epoxy. These organic materials have their own issues when subject to mechanical vibration or hysteresis that induce turbulence or blurring effect when longer use of thermal affects damage the image with strong thermal spectrums.

At channel S, which is input fiber face at the end is exposed to illuminated reflection to first incidental light. Hollow glass tube allows reflected laser from

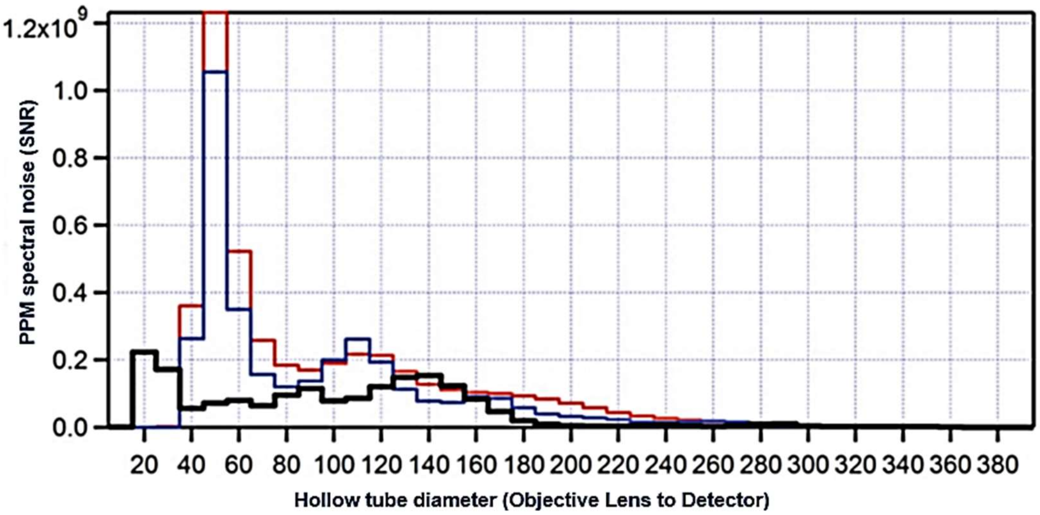

Fig. 8 Hollow PMT Spectral Distribution At Differential Fluorescent Light Scattering As Fraction Of Total Non-Bound Nano Particles Tip Leakage.

cascade reflective surface also mentioned channel 'C' to propagate without any aberration. The laser detector at the end records the reflecting waves from the two cross two orthogonal reflector at same stage found along the input area. Fiber interferometry issues are coped in associated sensors at ConLSCI. Low frequency induce the blurring effect in response to demodulation complexities and is resolved here by auto healing network of IoT time to time, calibrate and demodulate a given signal with standard accuracy. The calibration signal is an exact measurement for all the frequency dynamics in a high order transients. It is achieved with self-annealing attributes of auto-calibration instrumentation especially in an IoT sensor nodes. A noticeable interference exist when coherence is out of calibration usually in length a result of unequal length of path inside an interferometer where two supporting legs are mounted.

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We expose our methodology in ever demanding interest in confocal microscopy for steerable fringe interference pattern an outcome of difference in exaggerated path length maintain sensor channel (Channel C) concurrent length in consistent with twice length in hollow cavity as proposed in standard RBS indicators for Fabry-Perot gap length, also called cavity here, illustrated in Fig. 5. The fringe spectrum reflects any exceeded pathway in the Fabry-Perot cavity corresponds to asynchronous coherent or non-coherent reflected laser actuation. The absolute length of the Channel S is maintained as an indicator to absolute reference (also associated with calibration), in a way it is always fixed to keep pathway below the Fabry-Parot recommended cavity separation. The accumulative optical power of magnified dual reflections prohibit the occurrence of any interference or resultant infringes thus set the output power linear to the reference optical power. However vulnerability to fiber loss, dispersion edge loss, and attenuation of power are hard to control for both channels, unless compromised on cost-design time for high end hollow tube choices which leads to not a lucrative choice, when deployment scenario are for instance an IoT network hub. If we deem the thermal infusion of our sensor, the change in any temperature over a neighborhood of 4ºC, 14ºC, 24ºC. As shown in Fig. 6, it depends on fitting indicators directly associated with the gap length in a photon multiplier tube gaps.

The turbulence or fluctuations are catered in mechanical fitting of two channels such that their ratio is constant usually obtained cancelling the channel ‘S’ or ‘C’ gap out. In order to achieve full range of the measurement for desire optical intensity sensor probe is additionally designed where processing of data and interpretation of results become consistent with the sensor sensitivity at the other end where detector is mounted. A logarithmically linear relation is maintained at the interferometer to simplify the outcomes in a desired range of measurement. We achieve it while fabrication of capillary tube alignment with the laser actuated sensor, primarily active source of non-invasive illumination at controlled geometrical parameter as length, radius, surface area, breadth and elasticity strain or stress modulus. Here readers can well imagined, this benefit is exploited due to flexibility offered by the choice of non-organic adhesive methodology. A straightforward sensor in our methodology is restricted to provide best optical feature while maintaining non-invasive attributes intact for both specimen and framework, while secondary analysis for decomposition of output spectrum or counting of fringe in Channel C is a joint task for EDA and hosting platform on standard computer.

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A. Grating-Assisted Operating-Point Limitations

The diffraction limit of ConLSCI prevents optical imaging beyond the micrometre scale. The ultra-miniaturization of near field optics is subjected to objective lens of the confocal microscopy and nullify the diffraction of asynchronous reflected beams. We adopt a standard practice of 0.1 micro meter radial laser source, which not only reduces the limitations imposed on diffraction but also equally mountable in a Fabry-Perot cavity as in our ConLSCI. The near field brings the laser source close to the field or specimen, increasing image dot per inch pixels for a narrow radial laser source. Here we expose the capillary-compact fabrication of sensor warmed to CO2 laser and set to reasonably pointed edge for compatible mount. The silver coated reflective surface becomes the major intensity lobe which reflects completely internal as in other optical microscopic instruments, electron microscope to name.

Fig. 6 are L-V curves at different temperatures. From the driving current at which the LED has a CWL of 1551 nm can be determined for different temperatures. In lower curve as intrinsically dependence on temperature, optimal working points are labelled by open circles and the corresponding output power can thus be found. It can be seen that in order to have the highest power and the best CWL the ConLSCI sensor has to work under high temperature and large driving current. However, both of conditions may shorten the operating life of the ConLSCI sensor and E2LED. Currently, the working conditions are chosen to be 84 mA and 14 °C, with an output power of 52 µW.

B. Laser Ablation Limitations

Evanescent waves are attributed to refraction of light which bends in the media of capillary tube tip, hence prone to laser beam leakage out of the sensor tip. This anomaly is corrected bringing the specimen and the laser source in the closest vicinity, which allows adjustment of petri plate for appropriate raster and creating a sharp high resolution NFOM in near field of optical signal mapping fluorescent 3D image. A small amount of the light leaks out of the tip via the evanescent wave. Unlike NFOM which is particularly benefit cells and tissues image-planes capturing, the Scanned Near Field Optical Microscopy (SNFOM) yields far better resolution, when exposed to observing a surface as fine-grained as to reach 100 nm. The excitation wavelength plays a key role while nanoparticles visualization is recorded onto fluorescence segmentation needs to maintain emission properties compatible along excitation system. The scattering mode for ambient light and fluorescent mode, the nanocarriers leakage induces large particles distributed equilibrium mostly in region 15 nm to 62 nm. The leakage concentration is shown in Fig. 7 while ambient light or fluorescent scanning. Longer exposure and capture time prevent tracking of particles especially at low concentration, mainly due to fractional light leakage. The right dilution may is determined once we adjust both channel 'S' and channel 'C' at the confocal hollow tube on a cascade reflectors eliminating high pass filters as shown in Fig. 7 (b). Large topographic scans when subject to low concentration nano particles contain the bound components of leakage, need to be adjusted with two tubes shown in Fig. 2, their distribution before and after the relative encapsulation is measured differently in both ambient laser and fluorescent light depicted in Fig. 8. The encapsulation for parts per million particles over the leakage spectrum is termed as signal to noise ration mentioned along vertical axis, where effective encapsulation of hollow tube diameter is strictly a function of laser actuated channel length along the objective lens to detector end. Whereas various sample specific structure, probe tip scattering flexibility (due to non-polished edges) significantly contribute to nano particles formation spectra, recorded at analogue to digital module or camera CCD resulting enhanced resolution image. This phenomenon is similar to scanning luminesce microscope regular imaging, where leaking effects are manually removed at the data acquisition block by some aggregating or interpolating techniques such as down sampling. But these operation induce another noise, called quantization noise, prevalent in most digital processing signals. We reduce this by incremental imaging in various bit-planes and projecting on the CCD without any optical or digital processing, thus provide a large canvass of possible analytic operation at the researcher desk. Unlike [27, 41, 42], we brought forth and develop fluorescent segmented microscopy in achieving following objectives:

First, a prior knowledge of sample, provides flexibility in marking the fluorescence to the Region of Interest (ROI) at laser actuated probes without sacrificing the potential leakage incidences, as mentioned above.

Second, a deeper structural penetration is achieved in imaging biological entities as cells, tissues or geometrical features vide their UV spectrum or two-photon scattered illumination at the laser actuated probe tip.

Third, similar to UV spectrometer where deuterium or tungsten illuminate the cuvette specimen or flow cells in a monochromatic ambience the detector at PMT and data acquisition boards have similar configuration as shown in our ConLSCI as shown in Fig. 2. Hence results are comparable for significant contrast and our contribution to work.

Fourth, laser actuation in our probe is non-adhesively mounted, enabling its yield over a large spectrum of cells, tissues, micro-organisms, material lattice structure, nana-surface analytical modeling.

The ever growing demand for higher resolution bit plane imaging in micro-organism is restrained by the fine pitched laser actuated probe mounting or materials. These limits are overcome with thermally annealed wide range of L-V curves, as shown in Fig. 6 across 1551 nm illumination, which yield a superior, reliable, robust and stable fluorescent highlights of specimen either a living cell or substrate doping in computer chips.

4. Conclusion

In this work, we highlight and derive the decision indicators for laser actuation point of care detection (i.e., a sample located at a laboratory or remote smart hubs) in the Instrument-in-Loop (IiL) to facilitate better Time-to-Deployment (ToD) for a given scenario, such as handheld measuring instrument to meet the demand for smart instruments. Industrial Process Regulation (IPR) put forth additional challenges to working knowledge expert in expediting the transformation phase of an analytical model, while a comprehensive history of techniques and off-the-shelf devices intact the ToD. Smart instrumentation industry paradigm shift has amplified the demand for intelligent remote sensing node together with requirement of the smart urban planning i.e., low form factor to accommodate OEM, and high performance speed to meet the data traffic demand as generated in any sensing point on a typical IoT network. We expose in this work aforementioned objectives, taking into consideration computing intensive non-linear analytical techniques which add another layer to the key industrial instrumentation. The miniaturization technology to 7nm scale encourage us to tailor the demand in a non-invasive instrumentation, widely used in scanning of microorganisms both in vitro and ex vitro experiments as well as monitoring such as living cells, tissues and material nano meter topographical scanning. This conforms analytical observation and experience commenced by scientist, researcher or industrial use case lead into the miniaturization, hence termed as Lab-on-Chip (LoC); which not only evaluate comprehensively a specimen with a correct choice of instrumentation in place, but also enable smart IoT devices subject to scenario constraints on an appropriate applications such as tip laser light leakages, micro form factors, fluorescent segmented imaging and two channel (‘S’ and ‘C’ at ConLSCI). Confocal Microscopy due to its large 3-D visual vulnerability to extract topographical, morphological and composite feature of specimen under consideration. The rastered back and forth 3-D imaging technique enable use of Confocal Microscopy its widest application in biological and material sciences and hence rose challenge of predicting large missing or incorrect data obtained during experiments. We observe that the spatio-temporal measurement can be preserved modelling the ergodicity of information flow across the five components, mentioned above. The visual vulnerability specimen for Confocal Microscopy is contributed due to its large 3-D visual spectrum to extract topographical, morphological and composite features. The rastered back and forth 3-D imaging technique enable use of Confocal Microscopy for its widest application in biological and material sciences and hence rose challenge of predicting large missing or incorrect data obtained during experiments. We observe that the spatio-temporal measurement can be preserved modelling the ergodicity of information flow across the five components, mentioned above. We discuss flexibility in marking the fluorescence to the Region of Interest (ROI) at laser actuated probes without sacrificing the potential leakage incidences. Like UV spectrum microscopy our lab-on-chip enabled ConLSCI exhibit deeper structural penetration, achieved in imaging biological entities as cells, tissues or geometrical ROI features. The robustness of system is tested against a large variety of luminescence to propagate disturbance across the five components of any spectrometer microscopy where deuterium or tungsten illuminate the cuvette specimen or flow cells in a monochromatic ambience the detector at PMT and data acquisition boards. We deem an optimal scenario on a typical Pareto wave front subject to optimization and deployment constraints, thus naturally demands Phenomenal Analyses of Interest (PAoI). Our lab on chip frame work targets the scenario where deployment of instrumentation nodes together with an IoT are regularly calibrating and yield in support with cloud intensive computation and reliable database. In a smart urban sensing node environment a laser actuated non-invasive scanning adhere to LoC accuracy for a mobile environment, suitable to equivalent precision but much faster response. Such conflicting objectives often lead to less accuracy though zero time field operations, most unlikely in traditional laboratory practices having strong foundation on pedantic methodologies, especially faced in CovID 19 unavoidable detection at large field scale with zero risk constraints, to name a few. We encourage technologist to adopt ConLSCI framework suitable to smart instruments in any IoT network sensing node which are rapid-pace, self-adjustable to perform multiple scanning session in parallel on-demand. Only AI-enabled, fast cores provide such automated measurements, presumed to be self-calibrated over a precise time, due to its visibility to Always Available Always Online (A3O) connectivity at IoT sensor nodes. Furthermore, it conforms to 5G smart deployments enabling machine-to-machine integration while real time Product Specific Environment (PSE) for example, pharmaceutical industry, virology labs or incidence of epidemic contacts; while maintaining conformance with Regulatory Bodies Standards (RBS) subject to analytical scientists.

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Table I: List of Acronyms

Acronym	Description
CFM	CHEMICAL FORCE MICROSCOPY
CONLSCI	CONFOCAL SELF CALIBRATED INTERFEROMETRY BASED LASER SENSOR
COVID 19	CORONA VIRUS ID 19
CWL	CENTRAL WAVELENGTH
DAU	DATA ACQUISTION UNIT
DPI	DOTS PER INCH
E2LED	EDGE-EMITTING LED
EDA	ELECTRONIC DATA AUTOMACHINE
IIL	INSTRUMENT-IN-LOOP
IOT	INTERNET OF THINGS
IPR	INDUSTRIAL PROCESS REGULATION
LOC	LAB-ON-CHIP
MEMS	MICRO ELECTRO MECHANICAL SYSTEMS
ML	MACHINE LEARNING
NFOM	NEAR FIELD OPTICAL MICROSCOPY
NIR	NEAR INFRA RED
OEM	ORIGINAL EQUIPMENT MANUFACTURER
PAOI	PHENOMENAL ANALYSES OF INTEREST
PID	PROPORTIONAL INTEGRO
PMT	PHOTO MULTIPLER TUBE
PSE	PRODUCT SPECIFIC ENVIRONMENT
RBS	REGULATION BUREAU SERVICE
ROI	REGION OF INTEREST
SEM	SCANNING ELECTRON MICROSCOPE
SLM	SCANNING LUMINANCE MICROSCOPE
SNFOM	SCANNED NEAR FIELD OPTICAL MICROSCOPY
SNR	SIGNAL TO NOISE RATION
TOD	TIME-TO-DEPLOYMENT