The Fluid Discontinuity Theory

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Abstract — Theoretical Physics is perhaps the only class of philosophies that has really enhanced and evolved itself to a lot of extent seeking clues towards the ultimate nature of reality. Stretching from the Theory of General Relativity and Quantum Physics, it’s been diversified with quite peculiar answers to multiple deep facets. However, still there is a significant fragment of Physics which is yet to be developed in that theoretical frame of system where the mathematical analysis turns in a more definitive role and thus, holds the intersection of certain other branches of the field and this area is Fluid Dynamics or Hydrodynamics. Although there is no question over some forsooth brilliant contributions in the regime but still, this discovery will deal with a nonpareil strand in order to fill some gaps which will determine new findings to lead the coming times much exclusively through the realm. The proposed discovery in this paper, being chronicle on the most primordial basis; is about quilting the distinction of waves as a whole in the fluid being in layered form and its impact via penetration of mass into those in form of respective disturbance in its fabrication of fundamental geometry. In other words, the idea proposed is about investigating and evolving the understanding of fluid discontinuity in distinctive extents forming geometrical patterns which is the idea that has also been undertaken to insights by some of the greatest Philosophers, Physicists, and Mathematicians of the last two centuries from Helmholtz to Lord Kelvin to Einstein but unfortunately it could not be attained in a full turn of deeper understanding in terms of Theoretical and Mathematical evolution as attempted by all these greatest forefathers of Sciences. In order to extract the idea with the overlap of modern mathematical integration, the entire formation of the defined system is taken into the account by establishing geometrical interpretations which will also develop more proteme insights into the field and fill many further gaps in the classical regime of the Dynamics and gives a modern turn to it. The fabrication of the idea is systematically unfolded in terms of both Theoretical & Mathematical engagements concerning to the respective structures taking place in form of different theories partaking in an evolutionary methodology.

Keywords — Fluid dynamics, hydrodynamics, hyperbolic prerequisites, geometrical connections, gravitational inclination, mathematical relations.

I. INTRODUCTION

The distinctive place of fluid dynamics or hydrodynamics in classical physics is attributed to many foremost intellectuals, be it initiated by Archimedes of Syracuse, Leonardo Da Vinci, or taken forward by relatively modern physicists and mathematicians e.g., Daniel Bernoulli, Leonhard Euler, etc. However, along with the modern interpretations, a turn in the regime comes when physicist Hermann Ludwig Ferdinand von Helmholtz came up with three theorems or laws in terms of the conceptualization of vortex which amplified much in direction of the evolution of geometrical structures in hydrodynamics that has subsequently developed as the modern leap of mathematical inclination towards the area. However, William Thomson (Lord Kelvin) also carried out brilliant distinctions in order to modernize the fluid dynamical approach which was later diversified by Albert Einstein in his 1924 paper as a tribute to Lord Kelvin representing some pre-occupied topological factors in Kelvin’s discoveries. But, going in a methodical way and looking at the current framework of fluid dynamics determining the peculiarities concerned with the sufficiently dense to be a continuum not exhibiting containment of ionized species and have flow velocity being small in relation to the speed of light in terms of the foundation to this proposition. Having the momentum equations for Newtonian fluids corresponds to the Navier-Stokes equations which is a non-linear set of differential equations describing the flow of a fluid that holds its stress depends as in the Newtonian two dimensional momentum and mass conservation confined as condensed into the following known mathematical system:

\[
\frac{\partial}{\partial t} (\nabla^2 \psi) + \frac{\partial \psi}{\partial y} \frac{\partial}{\partial x} (\nabla^2 \psi) - \frac{\partial \psi}{\partial x} \frac{\partial}{\partial y} (\nabla^2 \psi) = \nu \nabla^4
\]

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This base will also imply the resolving notion of vortex in the standard axial frames which will turn standard stream function $\psi$ into something which penetrates to three-dimensional or can even extend to four-dimensional regime so then after, it will not remain the general two-dimensional streamlined function. However, there will not be any actual or conventional stream function that really extends to higher dimensions with this analogy but mathematically; it will be expressed in the below non-degenerate 2-form considering surface as a prerequisite for a three-dimensional realm which is fundamentally given as:

$$U(x)\int_{\mu_d} \frac{\text{det}(\phi(i) \ldots \phi_o(j))}{\partial(\rho(\eta)|\psi)} = \nabla^2 \left( \int_{\psi} \left( \sum_{i \cap j} \frac{\partial \mu(z_i)}{\partial(r(\eta_i),j)} \right) \right)$$

(1)

Here, $U(x)$ is determining the substantial position that takes $n$ number of deviations into its account and $i$ & $j$ are indices for 2-form variance in the positioning of mass contains in $U(x)$; because the mathematical system & theoretical idea deals with incompressible & non-diffusive (mostly i.e., apart from special conditions), hence the density everywhere is expressed as $\rho = \rho(\eta)$. $r(\eta)$ is the rate of viscosity which can also be looked upon via an extracted version from kinematic viscosity $\nu$. In this frame, the $\phi(\ldots)$, which is a well-defined element of one-dimensional generalization up to higher dimensional methodologies such that defined in one of the most illustrious discoveries in the fluid dynamics i.e., on the one-dimensional internal waves arises in deep fluid particularly taking the conditions contemporary as water and the idea of accomplishing such mathematical system is towards the attribution to the eminent Mathematical Physicist-Thomas Brooke Benjamin. Whereas $\phi_o(\ldots)$, to all intents and purposes, the delineation in the relativistic form to the previous one and the entire relation in betwixt will behave as the convolution termed as Hilbert Transform expressed in the same. Now, coming back to the stream function as described to be generalizing up to a higher dimensional regime. So here, two foundational elements indispensable to be noted, given by:

$$u_x = \frac{\partial \psi}{\partial y}; \quad u_y = \frac{\partial \psi}{\partial x}$$

Hence, assuming $\mu(z)$ being the entire generalization of all statutory dimensions with respect to the corresponding indices. Thus, using the very first mathematical framework - (1), the stream function will instinctively integrate itself to an extensive diverse form into the structure concerning dimensions, however, because they exhibit axisymmetric streamlines, therefore considering rotational and translational symmetry in the system; the four-dimensional peculiarity will turn in the ordaining of either continuous or discrete; as two-dimensional being inducting towards the point of intersection of specific one-dimensional forms of internal waves that correspond to what previously described in the arbitrary functional distinction. In pure two-dimensional form, both prescribed foundations of stream function will simultaneously be taken as any arbitrary $u_d$ considering $u_x \cap u_y$. However, the reach for vital abbreviations in the basic form of stream function is more than enough now, but even the current understanding of fluid systems holds the conceptualization of what is described, the mere difference is towards generalizing the dimensional facet. Looking at the current scenario where its already given as a significant indication goes like; as two-dimensional biharmonic operator i.e., $\nabla^4$, even in two-dimensions have a distinctive relation on the terms relative to three-dimensional Cartesian coordinates that has the following form of:

$$\frac{\partial^4 \psi}{\partial x^4} + \frac{\partial^4 \psi}{\partial y^4} + \frac{\partial^4 \psi}{\partial z^4} + 2 \left( \frac{\partial^4 \psi}{\partial x^2 \partial y^2} + \frac{\partial^4 \psi}{\partial y^2 \partial z^2} + \frac{\partial^4 \psi}{\partial x^2 \partial z^2} \right) = 0$$

upto this point, all these mathematical ingredients are quite basic but as the theory goes in the mechanism of theoretical annotation, then the very initial catch is in the geometrical interpretation which in the Cartesian system and basic structure of dynamics of these mathematical unfolding, apart from the original mathematics established in the framework - (1); are more inclined towards the parabolic ordered systems but while approaching to the relativistic fluid mechanism or hydrodynamics in the way expressed primordially in the theory; prerequisites has to be taken in the hyperbolic distinction due to the engagement of flow distortion and breaking of continuity as under consideration, while that is also due to the theoretically structured framework in terms of the geometrical diversification of the fluid in its continuity. Here the question arises is the cause of any such discontinuity whose answer goes in simplified terminology of any object exhibiting symmetry of certain mass. However, once the object penetrates the ground of any fluid it will diversify its geometry in such a way that the hyperbolic systems will come into its mathematical course of action when presuming enough respective gauge boundaries such that fundamentally given as:
\[ \mathcal{D}_\mu \xi^\mu |\Omega| = \int_{\Omega} \frac{\omega \epsilon (\kappa_1 |\kappa_2)}{\delta_{\alpha\beta}} ||d\omega|| \]  

(2)

The field \( \mathcal{D} \) is hereby expressed as a metric preserving connection of \( \omega \) over the conformal entity \( \Omega \). Hence, the boundary condition is under the conformal transformations itself such that the geometrical perspective diversifying in the 2-closed form boundary with sub-fields corresponds to the subset of \( \epsilon \) which are determined along with the coupling factor \( \kappa \) pertaining to arbitrary but respective indices as which will always exhibit invariance under the other indices of \( \alpha \& \beta \):

\[ \delta_{\alpha\beta} ||\Omega|| \leftrightarrow (\kappa \leftrightarrow |e^1 \bigwedge e^2 \bigwedge e^3 \bigwedge e^4 \ldots \ldots |) \in d\omega \]  

(3)

The notion \( \delta_{\alpha\beta} \) makes the conformal system remain in the normed 2-form as shown hereby; whose commensurable aftermath \( \xi^\mu \) abides diffeomorphism of hydrodynamical geometry in the hyperbolic framework as a local function whose association integrates the neighbourhood points such that the quantization deal as a certain vector field:

\[ \xi^\mu = \int \partial_\mu \left( \sum_n \delta_n^\mu \right) \]  

(4)

Along with this, the induced normed system \( \delta_{\alpha\beta} \) that yields the non-degeneration of 2-form will be defined in the arbitrary but certain likewise field as below:

\[ \int_{U(\omega)} \delta_{\alpha\beta} \partial_\omega = \mathcal{L}_\xi \psi |\omega| + \partial_\omega \delta_{\mu\nu} \partial_\mu \epsilon^{\mu\nu} \]  

(5)

Where \( \mathcal{L}_\xi \) is the usual lie derivative, \( \partial_\omega \) is the infinitesimal angle deviation that describes the variational fabrication in the entire system projected with any constancy \( \gamma \) which will not come up with any potential difference in the mathematical segregation. Here, at the very first hand; it is observable that the mathematics in the framework - (5) do exhibit the variance whereas, it is quite primordial from previous elements that the local convolution system yields invariance; so it seems a bit self-contradictory notion, but discerning minutely will make it favour the generalization of both of them because previously, there are fields metric preserving that takes angles and also to other deviations into the identical account; while the last in the above framework has excluded the preserving distinctions which also shows that even non-preserving elements at the quantum states, can also mathematically behave as preserving components in certain conditions. Henceforth, the hydrodynamical system pertaining to the fundamental idea; exhibits variance under the pre-dominance of local invariance.

In the meantime, the mathematical effect of an object in terms or relative to the fluid containing directed velocity will certainly show the variance inside the fluid while penetrating deeper into it; however, if taking into consideration of the fluid media in a way of a certain field, then the mathematical system formulated will be:

\[ \left( \sum_n c_n \right) \int_{U(\omega)} \frac{\delta_{\alpha\beta} \partial_\omega}{\kappa \alpha \Gamma_\kappa^{\alpha\beta}} \partial_\omega = \mathcal{L}_\xi \psi |\omega| + \partial_\omega \left[ \sum_n c_n \right] \int \frac{\xi^\mu}{\omega} \partial_\mu \epsilon^{\mu\nu} \]  

(6)

The velocity \( c_n \) represents the conformal engagement to the vector field whereas \( c_o \) is in relation to the same determines scalar covariance over the smooth connections of \( \Gamma \) exhibiting the vector relations in a comprehensive scalar field due to quantization and \( \partial_\omega \) represents the general norm of Einstein's summation convention.

In all of the above terminologies, there is still a gap to be filled which is an indication towards the notion of gravity which, when possesses its intervention in the framework; then for functionalizing gravitational phenomena in a discrete way, the formalism will be as the inclination on its primitive extraction of all the non-preserving metric such that, it will constrain to lead the isomorphism to any of the relations in local transformative components, even the same case implies to the diffeomorphism in the devised field equation that will intrinsically give rise to metric tensor to an extent that undertakes the stickiness distinction of connections in the coupling 2-form of closed normed as follows:
\[
\mathcal{D}_\mu \xi^\mu \frac{\Omega}{\sqrt{-g}} = \int_\Omega d[\omega_\xi \circ \omega_\lambda] \left( \sum_\chi e^\mu_\chi \right) \tag{7}
\]

Rewriting the above mathematical system in the linear dominance form will devise the coupling of a generalized form of one-dimensional entity that generalizes the gravitational field quantization up to higher dimensions as likewise and contemporary to the analogy of space-time mapping whose functional section is shown previously such that the coupling norm of one-dimensional stimulus will also involve the constraints as both variational and constants in 2-form i.e.:

\[
\mathcal{D}_\mu \xi^\mu \partial_\mu \left( \phi \sqrt{-g} \right) = \int_\Omega \partial_\mu \phi \circ \kappa \left( \chi \right) \delta_{\alpha \beta} \sqrt{-g} \tag{8}
\]

This one-dimensional system of internal waves also contains some angular perspective that retains its Hamiltonian as defined by Thomas Brooke Benjamin as:

\[
\phi^{(n)}_o = P_n(\mu) = P_n(\tanh \sigma \eta)
\]

It is already known here that the Hamiltonian of it is retained in the attribution of the Legendre Polynomial \( P_n \) of degree \( n \) such that:

\[
H(\phi^{(n)}_o) = \int_{-\infty}^{+\infty} P_{2n-1}(\phi, \partial_\xi \phi, \partial_\xi^2 \phi, \ldots \ldots) d\chi
\]

The energy content in this frame goes with:

\[
P_1 = \phi \quad \text{&;} \quad P_n = \left( -\frac{dP_{n-1}}{dx} + \sum_{i=1}^{n-2} P_i P_{n-1-i} \right) \quad \text{for; } n \geq 2
\]

It is because the notion of energy in this context is referred as:

\[
E(\phi^{(n)}_o) = \int (2\phi^3 - (\partial_\xi \phi)^2) d\chi
\]

All these are made familiar here just to reflect the angular penetration of object in variance which is shown to belong to even such a classical theory. So, in the geometrical frame of this idea; the domain of deviation ranges from origin to infinite in the form of unity in the consequence of the computational system. Hence there will be the identification of the corresponding hyperbolic angular phase in the ultimate mathematical diversification which will show all the prerequisite components that needs to resolve the final touch to the discovery, Hence, the endmost mathematical structure from which all the mentioned distinctions can be found is:

\[
U(x) \left( \Gamma^\kappa_{\mu \lambda} \Gamma_\mu \psi - \Gamma^\lambda_{\mu \lambda} \Gamma_\mu \mu \right) \mathcal{V}^3 \left( \int_\Omega \frac{\csc(h^{(\phi)} \chi)}{\chi} \phi_\chi(\phi(\kappa)) \frac{\partial \mu(Z_{\kappa})}{\partial r(\eta_{\kappa})} \frac{\partial \kappa}{\partial \chi} \right) e^{(\kappa/r(\eta_{\kappa}))} \left( \frac{\kappa}{r(\eta_{\kappa})} \right)
\]

\[
\sum_{\kappa=0}^{\infty} \sum_{\lambda=0}^{\infty} \frac{\det \left( \begin{array}{cccc} \phi_{(\xi)} & \cdots & \phi_{(j)} & \phi \left( \phi_0(j) \right) \\ \vdots & \ddots & \vdots & \vdots \\ \phi_{(j)} & \cdots & \phi_{(\xi)} \end{array} \right) \delta_{\alpha \beta}}{\psi(u_{\xi(j)}) \partial_\xi \phi_\xi} = 0
\]

\[
\left( \partial_\kappa \Gamma^\lambda_{\mu \lambda} - \partial_\mu \Gamma^\lambda_{\kappa \lambda} \right) \mathcal{V}^3 \left( \int_\Omega \frac{\psi_\chi(h^{(\phi)} \chi)}{\chi} \psi \left( \phi_\chi(Z, \phi_\xi(Z)) \right) \frac{\partial \mu(Z_{\lambda \omega})}{\partial r(\eta_{\lambda \omega})} \right) e^{(\kappa/r(\eta_{\lambda \omega}))} \left( \frac{\kappa}{r(\eta_{\lambda \omega})} \right)
\]

\[
e^{(\kappa/r(\eta_{\lambda \omega}))} \left( \frac{n}{r(\eta_{\lambda \omega})} \right) \sum_{\kappa=0}^{\infty} \sum_{\lambda=0}^{\infty} \frac{\det \left( \begin{array}{cccc} \psi_{(\xi)} & \cdots & \psi_{(j)} & \psi \left( \phi_0(j) \right) \\ \vdots & \ddots & \vdots & \vdots \\ \psi_{(j)} & \cdots & \psi_{(\xi)} \end{array} \right) \partial_\xi \phi_\xi}{\psi(u_{\xi(j)}) \partial_\xi \phi_\xi} \coth^{-1} \left( \sum_{n} \Delta \theta(n) \right) \tag{9}
\]
II. CONCLUSION

The original discovery certainly vouchsafes the geometrical interpretation of the fluid dynamics or hydrodynamics which develops the modern viewpoint towards the mathematical trajectories in this area of Physics. The paper encompasses not merely theoretical and mathematical insights into the idea of fluid discontinuity but also resolves the variational principles of the system to the surrounding analogy of fluids. Along with the mathematical frameworks in the discovery, there will be sustaining contrast of likewise applications in the regime by effectuating mathematics presented and carried out hereby. Although there are innumerable enactments to this ideology to establishing such mathematical & theoretical relations, a few applications to some meticulous are like propelling some missile underwater, locating trajectories of any object inside any liquid with or without its flow, will stimuli the dimensions in the contemporary and new-fangled gaming or virtual reality simulations and advance the computations in various significant facets of artificial intelligence & machine learning, etc. It will also annex plenty of peculiarities to other connected branches like Vortex Dynamics, Superfluidity, Magnetohydrodynamics, Topological Fluid Dynamics, Quantum Fluid, Quantum Hydrodynamics, Hydrostatics, etc. The paper is not dealing with any single theory; however, the idea is identical to the current context as previously described initially; but further mathematical operations to it will give rise to multiple theories of symmetry or supersymmetry, topological frames in the hydrodynamical variance or invariance and so on. Eventually and quite significantly, the theory or discovery concludes and produces final remarks of the winding up of two centuries of long-termed ideas addressed and ventured by some of the greatest legends regarding the formation of the geometrical patterns in or by the fluids by any means, hence the discovery is a tribute to the pioneering founding fathers of this great question i.e., from Helmholtz to Einstein.

REFERENCES