INTERNATIONAL JOURNAL
FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

www.ijraset.com

Call: 🕾 08813907089 | E-mail ID: ijraset@gmail.com

Interactive Visualization & Navigation of Computational Fluid Dynamics of Simulation Data

Renu Singh[1], Dr. S. P. Pandey[2]

[1]Research Scholar, Department of Mathematics, Singhania University, Rajasthan
[2]Head, Department of Mathematics, BDIT, Ghaziabad, U.P

Abstract: We explain a system to facilitate supports real-time interactive visualization of computational fluid dynamics (CFD) Simulation data. In the system the users can use and manipulation of visual primitives, such as isoclines and simplified, in an ongoing process of the simulation. A user can interactively select and specify the areas of the computational grid refinement, because during the simulation process, the implementation of the remeshing, and see the results of the improvement in simulated real-time status. The system is being used, the study of the two open-ended questions etc.
Keyword: Interactive Visualization, Computational Grid, CFD, Simulation.

I. INTRODUCTION TO DATA VISUALIZATION

In the computational fluid dynamics analysis, simulation and visualization tasks, usually as part of the complete independence. The importance of data visualization is clearly recognized in scientific computing Display of simulation results, exploration of large data sets, and interactive steering of computation all require some component of visualization. However, the demands imposed by modern large scale computational fluid dynamics simulations severely test the limits of today's visualization systems. Computational fluid dynamics simulations are capable of accurate Simulation of fluid flow.

The resulting data sets of such simulations are very large and information rich. This trend will continue as a solution to problems at higher Reynolds numbers, and therefore higher resolutions, is desire. Solving these problems will be possible as computers become more powerful and numerical solvers improve. We believe that this will become more efficient and more instructive, to perform a two-step process Simulation and Visualization at the same time. A special-purpose visualization system that can be directly coupled with a running simulation, for example, through a network Our basic assumption is that - regardless of whether it is stable or unstable - Calculate the transient solutions, the integration of the achievement of the final solution over time, this time, the com Having such a coupling system also allows for cooperation in the other direction: it makes it possible to "turn" a simulation
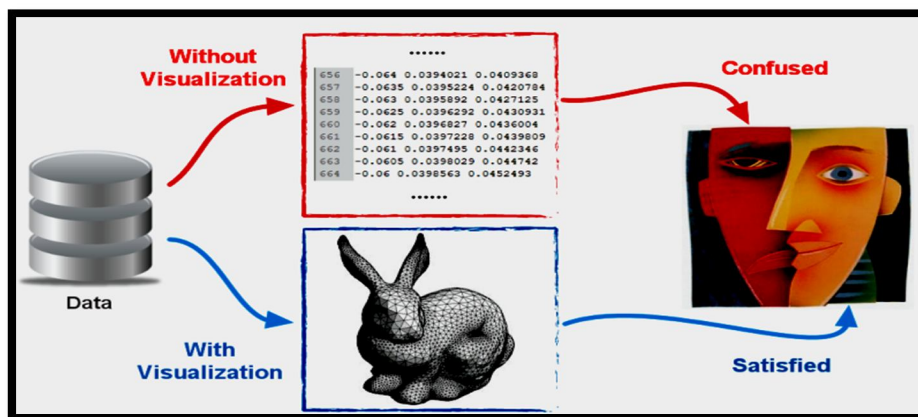

Figure 1: Showing a visualization example shows the comparison of the data analysis and exploration of data set

An alternative approach, based on the use of an algorithm that is used to modify the grid or automatic geometry, as part of the solution. The adaptive grid method, for example, the grid point within the region where it is most needed, such as shock or other areas in the vicinity of the gradient. Similarly, the automatic methods can be used to dynamically modify the geometry, in response to a computing solution. For example, automated CFD-based design approaches have been developed to optimize the Aerodynamic shape, in using a control theory as the basis for the formulation of the ad joint system and supersonic transport configuration. Description Details, and provides a concise summary of the aerodynamic shape optimization method.

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887
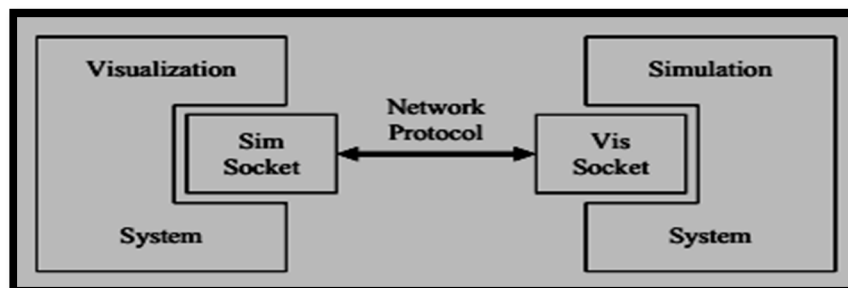*Volume 6 Issue IV, April 2018- Available at www.ijraset.com*

Figure 2: Showing the Layout of integrated Simulation of Visualization System

Even when using automatic or self-adaptation, interact Select the area of the grid, and to continue to improve the computation

II. THE WORKS OF RESEARCH

Calculate the Navigation has always been an active area of research for more than 11 years; a good survey or classification can be found in the existing system. The framework presented here is different from the existing steering system because it is based on an interactive data exploration system, therefore, focuses on the two with interactive visualization and steering. This is also the time was devoted to a different analog two or three dimensional space.

III. PROVIDES AN OVERVIEW OF THE GUIDING FRAMEWORK

One of the guiding frameworks is characterized by its close couple simulation and visualization/interaction. To use the visual program guidance, it must be" From one system architecture point of view, there are two ways to create a guiding framework: one can create a single program, which consists of two parts, or a construct two independent programs linked by a communication protocol To support separate development of the two program components, and to provide maximum flexibility.

IV. COMPUTATIONAL PROBLEM OF VISUALIZATION SYSTEM

The integrated simulation–visualization system, we have studied two problems in compressible fluid mechanics that involve flow at or near the speed of sound (transonic flow). These problems involve the reflection and focusing of weak shock waves, and are poorly understood theoretically due to the difficulty in analyzing multi-dimensional shock wave propagation. In particular, the weak shock reflection problem is a physically important example of a two dimensional Riemann problem, which arise in the study of hyperbolic systems of conservation laws, including the Euler equations of gas dynamics. Other examples of transonic flow the problem occurs in the aero application, for example, on the wings of the commercial subsonic transport aircraft in the cruise of the machine number. The transonic flow character

On the first issue, we study the transition between the machine and the current thinking about the weak shock wave reflection thin wedges, Mach and regular is not possible, the wedge angle $\theta < \theta d$, Where θd is the point of view of the detachment, which is a function of the impact strength. One possible, the transition from regular to mach reflection, therefore, this transition is taking place in the sub-teams, where $\theta = \theta d$. An asymptotic, describes the reflection of the weak impact on thin wedges of the fur is the detachment and sonic points correspond to different values of a parameter is very similar to the asymptotic problems of numeric values.
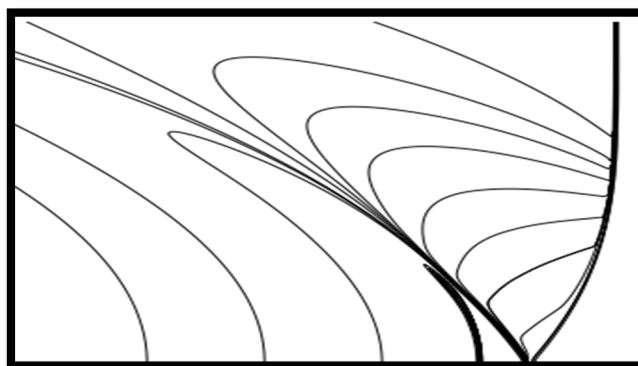

Figure 3: Showing the Solutions for shock focusing, linear fish-tail

We have solved asymptotic with the numerical method described. We use a curvilinear grid; there is a nice local regional harmonization of the grid, then a close to Sonic and ultra-off values and look for evidence of the transition to digital solutions.

The second issue relates to the impact of the bending work. When a weak non-flat-down dissemination of an electric shock, one of the tube configuration. If the shock is very weak, it crosses over itself, forming a linear, fish tail configuration as shown in the figure.
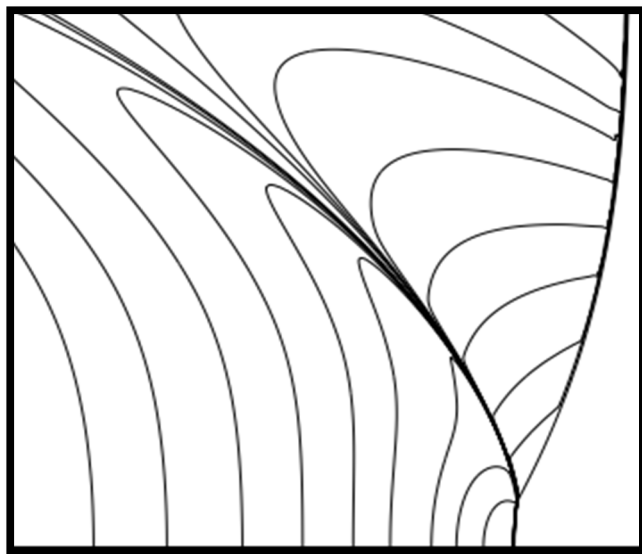

Figure 4: Showing Solutions for shock focusing, non-linear configurations.

For a slightly more forceful impact, non-linear configuration is observed; in this case, the central part of the accelerated to prevent electric shock, electric shock, the span will resolve the conflict between the theoretical and experimental issues. Further explanation, shock waves are focused.

It is necessary to study the issue; we focus on the shock with the figures set out in the scheme. We use Cartesian grid, there is a nice local regional harmonization of grid point three times in the vicinity, and stretch out nu exponential growth.

A. The Structure of the Visual System

Our goal is to create a visualization system that is fairly close to the analog systems, it may be a part of it, but general enough to be able to add a few different simulation systems without having to rewrite it everytime.The major advantages of such a tight-knit system are twofold: First, such a system supports interactive visualization of "live" simulation data

*B. The Interactive Visualization of Analog Data System*

Our Visualization System Closely followed by system architecture. It can visually display the grid structure a typical use of our system is to first explore a single transient solution is placed in the simulation, and drag the number of visual primitives; as soon as the prominent features of data have been placed, Automatic Data Update is enabled. A benefit of the distributed system architecture describe is that the visualization system can be connected to or disconnected from the simulation at will; therefore, it is not necessary for a user to continually supervise a long-running simulation.

C. The Visual Primitives

The interpretation the contour is probably the most commonly used. This algorithm is not appropriate, interact but by selecting a point of the domain. The visual system to calculate the scalar value at the selected point, we calculated an isoline is the value of the "growing" it out, from the selected points: first, an outline of the clips to the grid cell containing the selected point is created using the marching-cubes; second, it is to determine which edge of the cell, in addition to the main benefit of this method is that it can be interrupted at any time, enabling interactive response independent of data set size and allowing a user to "drag" a contour line to quickly and intuitively explore a scalar field.
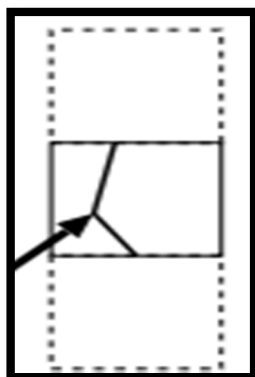
1) Showing Creating contour line fragment
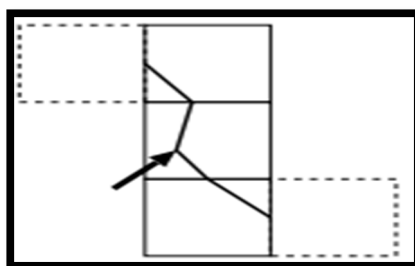
2) Showing Growing contour line by propagation
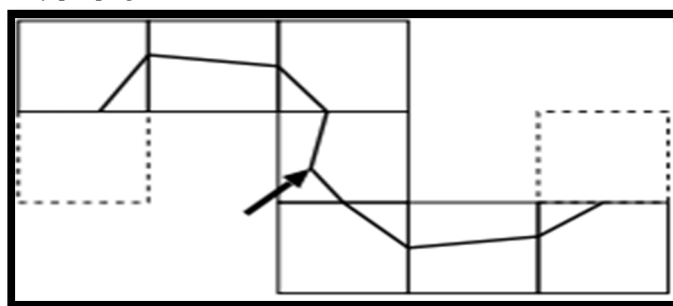
(iii) Showing the Growing contour line by propagation through adjacent cells
Figure 5: Showing Computing a Seeded Contour Line of Adjacent Cells

Simplification is a means to visualize a vector (flow) field data A streamline $p(t)$ is a solution to the initial value problem $p(t0) = x0$, $d/dt\ p(t) = f \lfloor p(t) \rfloor$ In a more physical sense, it describes the path of a mass less particle released into a steady flow field $f(x)$ at point $x0$.

The standard method at present, these two simple visualization primitives are the only supported. In this connection, the interactive layout of contour, simplifying is the most efficient way to visualize both the described behavior. Once we get a better understanding of how to calculate, tracking method it may be applicable.
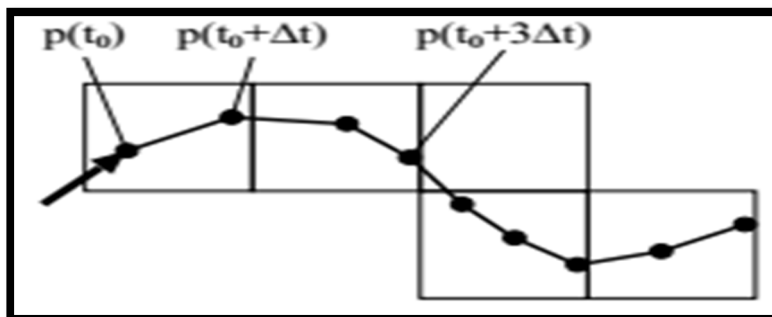

Figure 6: Showing Generating a Streamline

By iteratively solving an initial value problem starting at point x0 = p(t0) Currently, these two simple visualization primitives are the only ones supported. At this point, interactive placement of contour lines and streamlines is the most efficient way to visualize the two described phenomena. Contour lines, however, keeping the same seed point might change the data value visualized by the contour line. This updating method is sufficient to visualize a simulation's evolution

D. *Multivalve Data Component*
In this case, the multi-value data sets the data from different component x and y-component of the momentum, or the amount of momentum. Primitives can be column

E. *Analog Data Update*
The system to read pre-calculated data for the visualization Because all of the above visual Primitives in the use of this concept of a starting point or seed, we are updating all existing original by re-computing them, using new data from the same point. To simplify, it is appropriate for the contour lines, however, maintaining the same seed point might change the value of the data visualization of the contour. It is enough to visualize a simulation of the evo

F. *The Manipulation of the Simulation Parameter*
In a tightly coupled analog visual framework, data visualization, there is only one part of the Collaboration. If the visualization is used to "supervise" the analog, it can also be used to "Steering the simulation. The goals and objectives of the guidelines, that is, the interactive changing simulation parameters, can be a solution to increase the accuracy, reducing the run time, or maintain a simulated "track" for more information, see How to lead a simulation depends on the simulation of the phenomenon, or, more specifically, the parameter is exposed in the visual system and for the "adjustment" in the calculation process, the steering, fitted with a stand-alone simulation code interaction is often referred to as a "tool".

In both of these computing issues as mentioned above, we choose to instrument simulation code allows the user to change the grid during simulation, in order to adjust the regions most complete the most powerful position. In principle, the guiding framework can be adapted to control other analog parameters, at the same time, depending on the model of control.

V.   THE VISUAL SYSTEM ARCHITECTURE
The more complex a coupling visualization system is due to the fact that it must work closely together, in the simulation the Grid structure used in the calculation. In this two-grid grid (a) and (b), a place where the re-unification of the (a) curvilinear grid, using the reflection of the problem; (b) records.
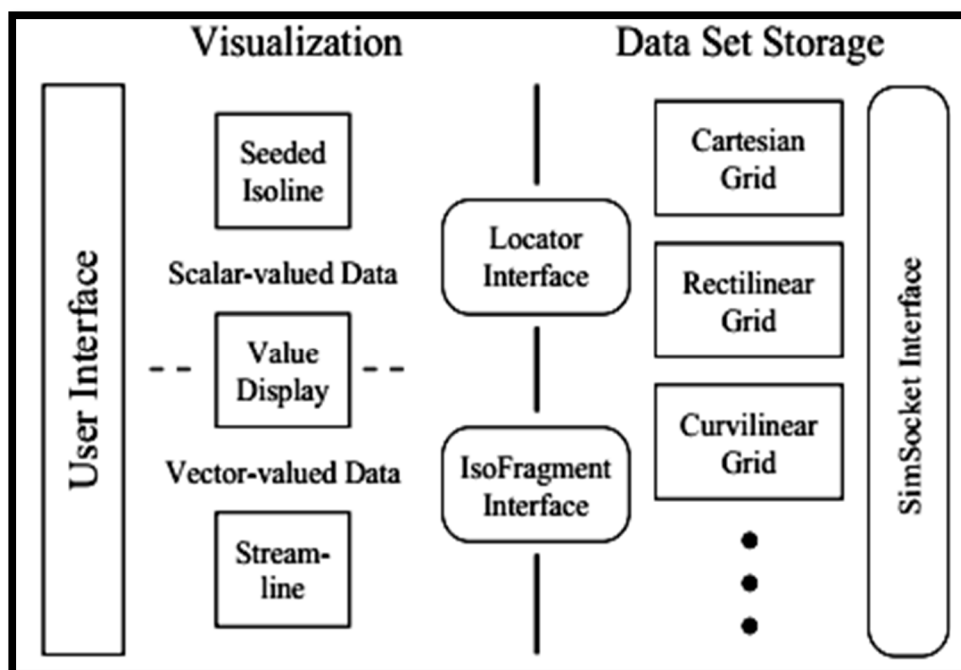

Figure 7: Showing the Architecture of Interactive Visualization System

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887
Volume 6 Issue IV, April 2018- Available at www.ijraset.com

The basic interfaces that allow for the isolation of the structure, the SIM card Our visualization system includes two main modules: the first set of data storage, processing of the sim card primitives, the seed of the isolines and simplified, on the local and isofragment interfaces. In addition to the locator to the role of the Iterator interface similar to that found in the C++ Standard Template Library. The isofragment interface is specific to the isolines generate seeds, it encapsulates how an isoline iteratively is generated, a line segment, the isolines how to propagate to the grid cells. Visualization System architecture as shown in the Figure 7.

VI.   THE RESULTS

We used the analog visualization system, and explore the impact of the solution of the problem described of the value of the parameter close to the detachment and the sonic point value. a complete solution in the digital domain, illustrate Our solutions, our local fine grid over a very small area and close to the click on the reflex point. In order to exemplify the size and location of the complete reunification of the grid. We draw a contour line of the x-component velocity u as a function of the (x, y/t/t) full digital domain. The figure shows the solution. Is a value of a corresponding to the reflection of the machine? The refined grid size is too small, not to
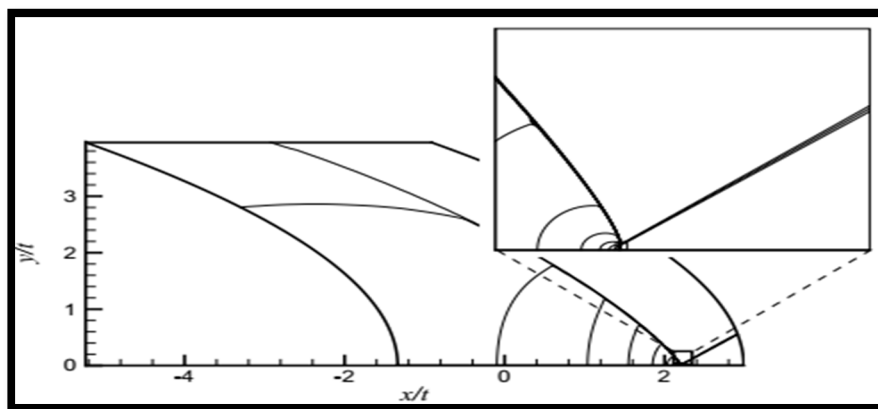

Figure 8: Showing a Solution on the Full Numerical Domain Plots Show Contour Lines of U-Velocity for a Mach Reflection near Transition.

In a calculation, we interactively, fine grid, until the solution in the near reflex points are adequately addressed. The Sequence of solutions as a com of this area contains the uniform grid and the corresponding area that shows the boxed-pages. In the process, we have the perfect every the factor is 2, the x and y/1/1 and the preview in the figure.

The impact of this incident has become more clearly defined as a grid. Here, the identification of solutions as a reflect machine we show u contour is a sequence of an appropriate solution on a regular basis, reflecting the transition. The number of grid points in the refined to a very close to Sonic and ultra-off value; however, we are not able to distinguish between different machines and registration the contours, as a function (x,y) for the solution at time t = 1 corresponds to the linear and non-linear configuration, click on the focus.

In our compound contour is non-linear, centralized solution, is limited to a small area of the reflective area. The number of points in the complete reunification of the grid in the area these solutions are preliminary and further work, including many extremely sophisticated solutions, is essential in order to address the solution for nearly three times the point.

VII.   VISUALIZE THE PERFORMANCE OF THE SYSTEM

Here We are routinely running the described simulation/visualization framework as a distributed application on two consumer-level desktop workstations the simulation system needs between two and three seconds to calculate a new transient solution. The visualization system is always interactive, panning or zooming of a fixed visualization performs at the above 30 frames/s, dragging of visualization primitives is performed at least 10 frames/s. the Transmitting a transient solution from the simulation system to the visualization system is limited by network bandwidth; in our environment and at typical grid size, the transmission time is between three and five seconds, during which time the visualization system is still responsive. After a solution has been transmitted, it takes the visualization system about 0.1 to 0.5 seconds to update its internal data structures and re-calculate all placed primitives, during which time it does not respond to user interaction. We have to run the simulate x 1500 cells, analog systems require two to three seconds to calculate a new temporary solution. In the visualization system is always in addition.

VIII. CONCLUSIONS & SUGGESTIONS FOR FUTURE WORK

The integrating simulation codes and interactive visualization systems offers numerous benefits for Exploring data in real-time simplifies the process of understanding data; observing an ongoing simulation aids in debugging the simulation program & also understanding the problem being simulated and interactively refining grids on the fly can improve simulation quality or reduce overall simulation time. We implemented such an integrated simulation visualization system for described problems. Even though these problems use similar underlying data structures, the described architecture encapsulates those differences inside a single module. with our system to compute highly refined solutions helped us to understand the inherent difficulties in the computational approach.

For Future work includes adding more visualization primitives as well as more data structures to allow us to couple of the visualization system with a wider range of simulation systems. For each simulation system, specific steering methods have to be developed and integrated into the existing framework in further improving our computational methods.

REFERENCES

[1] Theolella Erger M.J. B and C, "The Local Adaptive Mesh Refinement, Hydrodynamics" J. Com -- Put To the Vote. The PHY. 85, (1999), pp. 65-88.

[2] Frits H. Post, Gregory M. Nielson, and Georges-Pierre Bonneau, editors. "Data Visualization: The State of the Art." Springer, 2012.

[3] Colin Ware. "Information Visualization: Perception for Design," Second Edition. Morgan Kaufmann, 2014.

[4] L. F. Henderson, "Diffracting Shock Wave Systems Area and Boundaries," angew Z-order. A mathematical function. The mech. 77 (2007), pp. 83-87.

[5] J.D. Anderson "Computational Fluid Dynamics: the Basics with Applications" McGraw-Hill series in aeronautical and aerospace engineering. McGraw-Hill, 2005.

[6] J. K. Hunter, J. Glimm and A. Majda, eds., "Nonlinear geometrical optics, in Multidimensional Hyperbolic Problems and Computations", IMA Vol. 39, Springer Verlag, New York, 2001, pp. 189–198.

[7] D. Mavriplis, "Mesh Generation and Adaptively for Complex Geometries and Flows, Handbook Of Computational Fluid Mechanics," 418–469, Academic Press, San Diego, CA, 2006

[8] C.S. Orawetz M, "Potential Theory for Periodic and Machine Reflects A Shock, A Wedge, Comm., Pure Application. Mathematics," 57 (2004), pp. 553-614.

[9] Colin Ware. "Information Visualization: Perception for Design, Second Edition." Morgan Kaufmann, 2014

[10] J. D. Mulder, J.J. Van Wijk, Liere and R. Van, "Survey of Computational Steering Environment, the Next Generation of Computer System "16 (1) (1999), pages 118-130.

[11] W. E. Lorensen and H. E. Cline, "Marching Cubes: A High Resolution Three-Dimensional Surface Construction Algorithm Processing" '89(1997), pages 164-174.

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Call : 08813907089   ◯ (24*7 Support on Whatsapp)