**APPLICATION OF NUMERICAL METHODS**

**INTRODUCTION**

Numerical analysis nowadays is an essential part of most technological projects as well as other disciplines. Therefore, the need for result verification is critical throughout the design process so that the methodology and approach of the research can be trusted and that the designers have confidence in the estimated findings. The standard practice is to verify the outcomes against general relativity, empirical data, published research, different layout output and other numerical parallel programming. Benchmark or validation examples presented by programmers may sometimes be used for this purposes but they are not adequately detailed to address an entire spectrum of issues. The analysts must evaluate before conducting the numerical analysis whether accurate the input data is, whether the software tool can resolve the issue in question as well as how to assess the validation the data. Whereas the authentication of the process was followed by many professionals as part of the quality improvement protocol, costly losses often happened

**HISTORY**

The concept of numerical analysis predates the centuries-long development of digital computers. More than thousands years ago, linear interpolation was also in operation. Numerical analysis has concerned many great mathematicians of the past, as is obvious from the names of important algorithms such as Lagrange polynomial interpolation, Newton’s method, Lagrange polynomial interpolation, Euler’s methods or Gaussian elimination.

**APPLICATIONS**

Sophisticated numerical analysis software has become indispensable in modern life. People are able to perform mathematical modeling even if they are unaware of the simulations involved. This can only be achieved through reliable, high-end and efficient software. Some of the major applications of numerical analysis are intriguing, yet easy to understand.

**Car safety enhancements :** Car makers around the globe use numerical simulations to evaluate and enhance car safety. Pedestrian protection is also kept in mind while investigating car crash tests. The algorithms involved are partial differential equations and fed to the advanced computers to unravel optimal results.

**Airflow patterns in the Respiratory Tract :** It is quite common for patients in ICUs to undergo respiratory failure. Mechanical ventilation is a treatment that helps in the sufficient exchange of oxygen and carbon dioxide for the normal functioning of the lungs. Various mathematical models use differential equations and computational algorithms to develop laminar airflow in the lungs using ventilators.

**Financial industry :** Modern businessmen make use of numerical techniques to allocate their resources efficiently. Some of the problems addressed by such applications are manufacturing, storage, scheduling, investment and others. Quantitative analysts have expertise in this area, and use the algorithms in risk management and interest calculation.

**High hydrostatic pressure (HHP) processing:\*** This is a non-thermal process in which food and biotechnological substances are compressed under very high pressure of up to 1000 MPa to inactivate certain enzymes and micro-organisms. The treatment of fluid food is analyzed by means of numerical simulations. The enzyme is inactivated with the help of numerical equations.

**Weather predictions :** Numerical weather predictions (NWP) are based on a set of differential equations known as hydro-thermodynamic equations. Very powerful and energy-efficient computers are used to process the bulk data and the information is extracted in the form of topographical charts.

**Spacecraft Dynamics:** Increases in the size and complexity of spacecraft have demanded a complex mathematical model of its dynamics. To reduce the inconvenience and plan a smooth trajectory for the spacecraft, various open loop models are created because the dynamics in space behave very differently than they do on Earth.

**Price estimation by airlines:** Nowadays, airline ticket prices vary significantly, even for nearby seats within the same cabin. Airlines use computational techniques to increase their revenue, keeping a check on fuel, payroll, crew assignments and many other activities.

**Machine learning:** The numerical algorithms of Newton’s method and the Nestorov method are used in machine learning optimization. Artificial intelligence is another field where machine learning is applied with the help of numerical analysis.

**ADVANTAGES OF NUMERICAL METHODS**

Analytical methods offer the 𝐞𝐱𝐚𝐜𝐭 𝐬𝐨𝐥𝐮𝐭𝐢𝐨𝐧 (which is not always possible to obtain) at the expense of the long time spent in computing.

- Numerical methods solve the problem of 𝐭𝐡𝐞 𝐥𝐨𝐧𝐠 𝐭𝐢𝐦𝐞 𝐬𝐩𝐞𝐧𝐭 𝐢𝐧 𝐜𝐨𝐦𝐩𝐮𝐭𝐢𝐧𝐠, but offer only an 𝐚𝐩𝐩𝐫𝐨𝐱𝐢𝐦𝐚𝐭𝐢𝐨𝐧 of the 𝐞𝐱𝐚𝐜𝐭 𝐬𝐨𝐥𝐮𝐭𝐢𝐨𝐧.

- Numerical methods prove to be useful when one is able to prove the existence of the solution theoretically without being able to obtain its analytical form, at this moment, one usually turns to the numerical methods to get an approximation of the solution which robustness depends on the numerical method used.

**CONCLUSION**

Numerical analysis is the branch of modern computation that finds applications in the field of engineering, life sciences and even arts. It has a remarkable ability to predict the world around us. The calculations are mostly made by the computers using MATLAB, FORTRAN 77 and other software programs to minimize errors. Clearly, numerical analysis has proved itself as a boon to humankind, from ancient times all the way to today, and they will surely help us move forward into the future!

**GROUP MEMBERS**

1. Snehil Verma

(201114284)

1. Shubhankar Kumar

(201114213)

1. 3.Geetika Manker

(201114282)

1. 4. Shubh Asati

(201114258)