CONFERENCE REPORT

International Conference on Applied Numerical Modelling
Southampton England, 11th–15th July 1977

The aim of the conference was to 'facilitate the interchange of ideas by researchers in the various fields and to review and discuss recent advances in numerical modelling'. As can be seen from the proceedings of the conference (to be published by *Pentech Press*) a very wide range of subjects were discussed, this did not however mean the topics were oversimplified before presentation. Even though the topics were of a specialised nature much benefit was gained from observing other people's methods of solution and their criteria for choosing their particular system boundaries—which were seen to overlap to a significant extent in some cases. One striking feature brought out by this conference was the wealth of available mathematical techniques which can be brought to bear on such a wide range of problems. There seems recently to be a tendency to pursue analytic calculations to a much deeper level before a numerical solution is sought, this approach, coupled with increased computing power has now been seen to pay off handsomely.

Dr. Abbott had the unenviable task of presenting a keynote address for this conference, after which the lectures started in earnest, being roughly divided into seven sections:-

1. Regional Models
2. Hydraulic Systems
3. Environmental Models
4. Fluid Flow Simulation
5. Structural Systems
6. Thermal Processes
7. Numerical Techniques.

The Regional Model section included lectures on land allocation, water resources, resource depletion as well as such global properties as surface temperature and Ultra Violet exposure, which was developed into a skin cancer incidence model by Beadle. By the end of the first session we had been introduced to the use of such varied mathematical techniques as linear programming, the Hamiltonian formulation and entropy maximisation. This last topic was introduced by Rose in his paper on the Calibration of Spacial Interaction Models. Rose has postulated a method of selecting the perception function of spacial interaction models by satisfying the Maximum Likelihook Criteria and forcing the balancing factors to be close to unity. Calibration of the model is thus achieved using much less empirical data.

The Hydraulic Systems session started with a discussion by Dr. Nihoul of the circumstances in which a fully three dimensional treatment for circulation problems is necessary. The vertically averaged models are seen to be appropriate when density stratification and low current velocities are not present. A model for the study of the motion of stratified waters was presented by Fisher and Hannover using a vertically discretised model. Whereas salinity intrusion was studied by Leonard and Vachtsevanos using lateral integration over the width of the Hudson river giving realistic results.

Finite element methods were well represented in this section. Liu presented an interesting application of perturbation techniques and F.E.M. to the calculation of nearshore circulation due to breaking waves, particularly important in coastal erosion problems. Askar and Cakmak later used perturbation analysis to great effect, in considering harbour circulation taking into account nonlinearities in the flow. The time dependent partial differential equations were cleverly transformed to a set of time independent equations in the 'harmonics' corresponding to the various orders of the expansion parameter which was simply the ratio of the volume of the water entering the harbour to the total volume of water in the harbour. A comparison of the Finite Element and Finite Difference approaches with fractional time steps was made by Marshall *et al.* The conclusion that the F.D. approach is much faster than F.E. for their problem is based on the assumption that fractional time step schemes are not possible with F.E. Fractional time step schemes are, however, being used with F.E. by some workers.

The session on Environmental Models yielded its fair share of startling mathematical techniques. The applicability of one dimensional water quality models, was discussed by Barry Benedict who presented his method for modelling water quality near the point of outflow of a pollutant. These points were later discussed by Lewis and Riddle who have tried to evaluate the influence of wind and freshwater flow on estuary pollution, in this problem the vertical structure of the concentration is important. In the paper by Bush, Pinney and Walls an interesting method of representing the boundary condition on a moving boundary was presented, in this case the boundary was the reaction surface for SO_2 with NH_3.

Later that day, in the fluid flow simulation session, we were introduced to the concept of 'semi-elliptic' partial differential equations for boundary layer problems with 'weak' flow reversal. Two phase flow was then discussed by Huyakorn and Pinder who used a novel finite element formulation involving an asymmetric upstream weighting function in the weighted residual expression. This choice of weighting function compared well with the analytically soluble test problem of one dimensional flow, and in two dimensions overcame the difficulties encountered when a 5-point finite difference method is used.

In the final session on Numerical Techniques, the high standard of the lectures was continued. The main emphasis of the lectures was on boundary element methods (B.E.M.), which were appropriately first developed at Southampton. Dr. Liu started the session with a lecture on the application of Boundary Integral Solutions to groundwater problems. As is usual with B.E.M. the governing differential equation over the region is integrated using an appropriate Green's or Betti's theorem so that the problem is represented as a boundary integral, which is then discretised. As only the boundary is involved this method can be computationally much more efficient than finite elements and in fact more accurate for regions where the field variable changes rapidly, as interpolation in the interior of the region is much more accurate once the solution on the boundary is known. A clear comparison between finite elements and B.E.M. was presented by Brebbia and Dominguez for Poisson's equation using constant and linear elements. The last scheduled paper, by Nelson and Adey was the description of a system for automatic mesh generation, optimisation and data preparation for finite element programs. In view of the labour involved in these processes it is encouraging to see that such work is being done.

Finally, at the close of the conference a round of applause was requested from the floor for Dr. C.A. Brebbia and Mr. M.A. McSweeney in appreciation of the masterly way in which they had tackled the organisation of this very successful conference.

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