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Monthly Operation Rules Considering Reliabilty Levels for Multipurpose Reservoir Systems

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This paper presents a methodology of developing reservoir operating rules which can consider the reliability levels incorporated with the discharge policy. The operating rules were derived based on the regression and risk analysis of the optimally operated results by using the long-term historical and generated reservoir inflows.

The methodology was applied to the operation of the Chungju reservoir system which is consisted of two reservoirs and powerplants, and monthly operating rules were developed. Simulations were performed by using the developed operating rules, and the results were compared with the historical operation result. The comparison shows that the developed operating rules can not only significantly improve the output from the existing system but also improve the reliability incorporated with the output.

Comparative Evaluation of Multipurpose Reservoir Operating Rules Using Multicriterion Decision Analysis Techniques

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Selection of the best operating rule among a set of alternatives for a multipurpose reservoir system operation requires to evaluate many minor criteria in addition to the major objectives assessed to the system. These problems are sufficiently complex and difficult that are beyond heuristic

decision rules and experiences in case several noncommensurable multiple criteria are included in the evaluation. With the assistance of multicriterion decision analysis techniques, it is possible to select the best one among various alternatives by systematically comparing and ranking the alternatives with respect to the criteria of choice.

Evaluation criteria for multipurpose reservoir system operating rules were indetified and defined, and the multicriterion decision analysis techniques were applied to evaluate the four develped operating rules of the existing Chungju multipurpose project according to the identified nine multiple criteria. The application result shows that the methodology is very efficient to select the best operation alternative among a finite number of operating rules with many evaluation criteria for a large scale reservoir system operation.

A Study on the Derivation of the Unit Hydrograph Using Multiple Regression Model

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The purpose of this study is to derive an optimal unit hydrograph using the multiple regression model, particularly when only a small amount of data is available. The presence of multicollinearity among the input data can cause serious oscillations in the derivation of the unit hydrograph. In this case, the oscillations in the unit hydrograph ordinate are eliminated by combining the data.

The data used in this study are based upon the collection and arrangement of rainfall-runoff data (1977-1989) at the Soyang-river Dam site.

When the matrix X is the rainfall series, the condition number and the reciprocal of the minimum eigenvalue of X^TX are calcluated by the Jacobian method, and are compared with the oscillation in the unit gydrograph. The optimal unit hydrograph is derived by combining the numerous rainfall-runoff data.

The conclusions are as follows :

1) The oscillations in the derived unit hydrograph are reduced by combining the data from each flood event.

2) The reciprocals of the minimum eigenvalue of X^TX, 1/k and the condition number CN are increased when the oscillations are active in the derived unit hydrograph.

3) The parameter estimates are validated by extending the model to the Soyang river Dam site with elimination of the autocorrelation in the distubances.

Finally, this paper illustrates the application of the multiple regression model to derive an optimal unit hydrograph dealing with the multicollinearity and the autocorrelation which cause some problems.

Simulation of Moving Storm in a Watershed Using A Distributed Model —Model Development—

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In this paper for simulating spatially and temporally varied moving storm in a watershed a distri buted model was developed. The model is conducted by two major flow simulations which are overland flow simulation and channel network flow simulation. Two dimensional continuity equation and momentum equation of kinematic approximation are used in the overland flow simulation. On the other hand, in the channel network simulation two types of governing equations which are one dimensional continuity and momentum equations between two adjacent sections in a channel, and continuity and energy equations at a channel junction are applied. The finite element fomulations were used in the overland flow simulation and the implicit finite difference fomulations were used in the channel network simulation. The finite element formulations for the overland flow are analyzed by the Gauss elimination method and the finite difference formulations for the channel network flow are analyzed by the double sweep method having advantages of computational speed and reduced computer storages. Several recurrent coefficient equations for channel network simulation are suggested in the paper.

Improvement of Freshening Process by Means of Underdrainage Conduit

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This paper is concerned with the actual comparison analysis for the freshening process in the two selected experimental reservoirs. At the deep freshening reservoir, the salinity and depth of the freshwater layer were estimated by simulation technique using the quantitative equation for the two -layered flow structures. First of all, it is shown that the effects of underdrainage conduit in the lower were reported more effective for the control of upper layer salinity comparing with the case of no underdrainage conduit. Further the results of computation were later compared with the real observed values and the relating parameters of the salt-balance equation are conformed even though appoximately. Finally it was represented that the salinity of upper layer is easily diluted not only by the tidal gate but also by the underdrainage conduit in the lower layer of the freshenting reservoir.

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An Optimal Operation of Multi-Reservoirs for Flood Control by Incremental DP

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An optimal operation model for flood control for multi-reservoirs, the Hwacheon and the Soyanggang, located in the north Han River basin is developed by using the Incremental DP. The objective function is to minimize the peak flow at the confluense point. of the Euam dam, and the hydraulic and hydrologic constraints are established by considering the related laws as to the operation of dam in flood season, each reservoir and channel characteristics. In particular, the final elevations of each reservoir are induced to the conservation pool level in order to prepare for the secondary flood. In addition, the results of this model, simulation results and the single reservoir operation by DP are compared in terms of control and utility efficiencies, and also the peak flows at the confluence point for floods with various return periods are compared with the results of simulation using feedback control.

As the results, the control and utility efficiencies are more or less low in contrast with the results of simulation and the single reservoir operation by DP, and the peak flows at confluence point are high because of terminal condition of reservoir storage.

Acute Toxicity on Daphnia Magna for Electric Cable Factory Wastewater

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This study was to determine the static acute toxicity on Daphnia magna for the electric cable factory wastewater. Activated sludge process was used to treat the wastewater with three different F/M ratios, 0.36, 0.2 and 0.1mg COD/day·mg MISS.

The results of laboratory bioassay with Daphnia magna were as follows.

1) 24hr, 48hr-LC_{50} of the influent were 17.35% and 11.73%.

2) 24hr-LC_{50} of effluents treated with F/M ratio 0.36, 0.26 and 0.1mg COD/day·mg MISS were 26.69%, 32.70% and 38.36%, respectively, and 48-LC_{50} of these effluents were 14.48%, 27.88% and 31.58% respectively.

3) According to various F/M ratios, the ratios of effluent 48hr-LC_{50} to filtrated 48hr-LC_{50} were 1.58, 1.83 and 1.47, respectively.

4) Activated sludge process effluents treated with activated carbon had little toxicity on Daphnia magna.

Study on the Long-term Change of Nitrogen in the Tidal Area of River

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Several field surveys were conducted to investigate changes of water quality with time in a tidal river. Results indicated that nitrification process were dependent on the change of salinity and suspended solids concentration. Therefore laboratory batch experiments were conducted, using suspended solids and sediment taken from a tidal river, to study the effect of salinity on nitrification and to estimate kinetic parameters of it in the tidal river. Suspended solids and sediment were sampled at a point in the middle stream. Sediments were collected from the aerobic layer of mud. The change of nitrogen concentration with time was clearly explained with Monod growth model and kinetic parameters were obtained by curve fitting method, Changes in NH_4-N, NO_2-N and NO_3-N concentrations in the river ROKKAU with time were simulated well using Lagrangian reference frame and parameter values obtained in the laboratory tests. The mechanism of nitrification by suspended solids and sediment in a tidal river is shown to depend on tidal effects.

Migration Characteristics in Sine-wave Type Rivers

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This study is a model on the Migration Characteristics which developed by using the equations for conservation of mass, momentum, and for lateral stability of the streamed, as the model can be examined for magnitude and location of near-bank bed scour an well as rates and direction of meander migration in which sine-wave type rivers(SWR) of the small sinuosity.

It is evident from this study that the transverse bed slope factor B' and transverse mass flux factor a play significant roles, and show reasonable that the values are $B'=4.0$ and $\alpha=0.4$, respectively

It will be a useful guide in planning, design, construction, and development of SWR river-basin projects.

The Statistical Model for Predictiong Flood Frequency

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This sutdy is to verify the applicability of statistical models for predicting flood frequency at the stage gaging stations selected by considering whether the flow is natural condition in the Han River basin. From the result of verification, this statistical flood frequency models showed that is fairly reasonable to apply in practice, and also were compared with sampling variance to calibrate the statistical efficiency of the estimate of the T year flood Q(T) by two different flood frequency models. As a result, it was showed that for return periods greater than about T=10 years the annual exceedance series estimate of Q(T) has smaller sampling variance than the annual maximum series estimate. It was showed that for the range of return periods the partial duration series estimate of Q (T) has smaller sampling variance than the annual maximum series estimate only if the POT model contains at least 2N(N:record length) items or more in order to estimate Q(T) more efficiently than the ANNMAX model.

On Salinity of Conduit Discharge from Selective Withdrawal Apparatus

SUH, Young Jea, Rural Development Corporation/KIM, Jin Kyoo, prof., Civil Engineering Dept., Seoul National Polytechnic Univ.

A problem of outlet salinity from a stratified fluid with a well developed interface thickness consisting of an upper and lower layer differing slightly in density is considered. Three kinds of apparatus were used for the experimental test and salinity differences between inlet layer and outlet discharge were estimated by the functional relationship using the dimensionless values. For the critical incipient condition of withdrawal of upper layer, Densimetric Froude number is correlated by the inlet diameter and depth ratio in the tank.

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Capillary Hysteresis Model in Unsaturated Flow: State of the Art

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The purpose of this study is to analyse existing hysteresis models and propose a new type of model. The existing hysteresis models are classified by three types: interpolation model, scaling model and domain model, of which the domain model is based on the theoretical approach. Models which need one branch of hysteresis loop for calibration are developed based on the independent domain concept, however, they are not successful to accurately simulate the real data of Rubicon Sandy Loan and Dune Sand. There is a possibility that a new model is based on the dependent domain model considering the pore blockage effect against air entry for homogeneous porous media

(Model III-1, Mualem, 1984). Concludingly, a new type of hysteresis model is proposed by simplifying Model III-1 using a proper assumption.

Computation of Areal Reduction Factor and Its Regional Variability

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ARF(Areal Reduction Factor) have been developed and used to convert point I-D-F to areal I-D-F in many countries. In Korea, though ARF was calculated in the Han river basin by several researchers, it has a limit to apply to other regions due to low density of rainfall gauge station and shortage of data. In this study ARF has developed in areas of high density of rainfall gauge station, the Pyungchang river(the Han river tributary), Wi stream(the Nakdong river tributarty) and the Bochung stream(the Guem river tributary) basins by fixed-area method. And coefficient of variation of annual mean precipitation was presented to use ARF in other areas and its applicability was analyzed.

Analysis of Flow in an Open Chanel with Curved Section and Side Branches

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Hydraulic characteristics such as velocity, surface level and flow pattern in the curved channel are analyzed by model experiment, where model is scaled down by 1 : 20 for prototype channel containing side branch and curved section. The withdrawal of channel flow from channel is analyzed to find the effect on the curve section. The numerical scheme for shallow water equation using ADI method is verified through the comparison of hydraulic characteristics by experiment with that by numerical analysis in the side section of model channel. The comparison of numrical results with experimental data shows that velocity, surface level and flow pattern agree well for overall channel. Because of the relative contraction of cross section in the curved section caused by rectagular coordinate system, the velocity calculated by numerical analysis is faster in curved section than that from experiment, which can be improved using finer spatial grid in curved section. The characteristics of the curved section such that the surface level is higher in the outer zone of curved section and the velocity is faster in the inner zone are well simulated by both experiment and numerical analysis. The effect of side branch reaches within the zone of the curved section.

Application of Storm Runoff Model Small Watershed by Finite Element Method

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The distributed hydrolgic models are widely applied to estimate the storm-runoff with spatial variability in watershed characteristics and rainfall pattern.

This study was aimed to introduce the event-oriented storm runoff model using fininte element method, and to try it's applicability on small watershed.

The Yeonwha watershed was selected and 14 storm events in 1991 were used for the finite element model, and the simulation results were compared with hydrologic quantities.

Nonlinear Prediction of Streamflow by Applying Pattern Recognition Method

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The purpose of this paper is to introduce and to apply the artificial neural network theory to real hydrologic system for forecasting daily streamflows during flood periods.

The hydrologic dynamic process of rainfall-runoff is identified by the iterated estimation of system parameters that are determined by adjusting the weights of the network according to the non-linear response characteristics which is formed the model.

Back propagation algorithm of neural network model is applied for the estimation of system parameters with past daily rainfall and runoff series data, and streamflows are forecasted using the parameters.

The forecasted results are analyzed by statistical methods for the comparison with the observed.

Forecasting of Peak Flood Stage at a Downstream Location and the Flood Travel Time by Hydraulic Flood Routing

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The peak flood discharge at a downstream station and the flood travel time between a pair of dams due to a specific flood release from the upper reservoir are computed using a hydraulic river channel routing method. The study covered the whole reservoir system in the Han River. The computed peak flood discharges and the travel times between dams were correlated with the duration

and the magnitude of flood release rate at the upstream reservoir, and hence a multiple regression model is proposed for each river reach between a pair of dams. The peak flood discharge at a downstream location can be converted to the peak flood stage by a rating curve. Hence, the proposed regession model could be used to forecast the peak flood stage at a downstream location and the flood travel time between dams using the information on the flood release rate and duration from the upper dam.

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The Development of Point Heavy Rainfall Model Based on the Cloud Physics

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Recently the physically based precipitation model was developed by Geogakakos and Bras(1984) for the strom event. This is a modified version of the model. In a different way from the model, in this paper, it is emphasized that the hydrometer size distribution(HSD) is subject to rainfall intensity and effects on the productivity of precipitation. The two HSD functions are applied to the equation of the outflow water mass through the cloud top and base, products of rainfall rate at the ground level, storage of cloud layer. As an input we put the meteorological data observed at Chongju in Korea in our models and adjust the parameters included in it. The results show that in the model there is significant deviation between the hourly calculated rainfall rate and the observed data, while it is very small in the our model based on the two HSD.

Evaluation of Fly Ash Disposal Methods by Analysis of Leachate Migration

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There are needs to examine the consequences of a regulation in effect to control the migration of leachates from disposal sites. The main objective of this study is to illustrate the methodology to evaluate basic disposal designs for compliance with a certain regulation. The "100/100 rule" is selected for demonstration purpose which dictates that time for the leachates to travel a horizontal distance of 100 feet(30.5m) away from the property where the landfill or pond is located must exceed 100 years. The two primary methods for disposal of ash from coal-fired utility plants, landfill and

pond, are studied. Numerical groundwater flow analysis resulted in pressure had distributions and flux information in the corss-section of the domain while pathline analysis provided travel path and time of leachate migration to compliance zone.

A Spatial-Temporal Charateristics of Rainfall in the Han River Basin

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Continuously recorded hourly rainfalls during the wet season in the Han River basin are separated into single storm events between storms. For the storm events, storm number, total rainfall, duration, and intensity are analyzed, and the basin is divided into three areas, which have a similar rainfall characteristics.

The criterion of separation of independent storms, which is proposed by Restrepo and Eagleson, is examined and its criterion is compared with temporal characteristics of single storm events separated with time between storms.

Estimation of Runoff Depth and Peak Discharge by SCS Curve Numbers and Time Variation of Curve Numbers

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The validity of the estimates of runoff depth and peak runoff by the basin runoff curve numbers (CN-II for AMC-II condition and CN-III for AMC-III condition) obtained from hydrologic soil-cover complexes is investigated by making use of the oberved curve numbers(median curve number and optimum curve number) computed from rainfall-runoff records. For gaged basins the median curve numbers are recommended for the estimation of runoff depth and peak runoff. For ungaged basins, found is that for the estimate of runoff depth CN-III is adequate and for the peak runoff CN-II is adequate. Also investigated is the variation of curve numbers during rainfall, which is turned out to improve the estimates of both depth and peak of runoff.

Runoff Estimation for Small Watershed by Interactive Program

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The purpose of this study is to estimate the flood hydrograph and runoff at ungaged small water-

shed by using interactive program with geomorphologic and climatic data obtained from the topographic maps following the law of stream classification and ordering by Horton and Strahler.

The present model is modified from Allam's interactive program which derives the geomorphologic instantaneous unit hydrogralph(GIUH).

This program uses the results of Laplace transformation and convolution integral of probability density function in travel time at each station. This program is used to estimate the time to peak, the flood discharge and the direct runoff at the San Seong station in the Bocheong Stream.

Real-time Recursive Forecasting Model of Stochastic Rainfall-Runoff Relationship

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The purpose of this study is to develop real-time streamflow forecasting models in order to manage effectively the flood warning system and water resources during the storm. The stochastic system models of the rainfall-runoff process using in this study are constituted and applied the Recursive Least Square and the Instrumental Variable-Approximate Maximum Likelihood algorithm which can estimate recursively the optimal parameters of the model. Also, in order to improve the performance of streamflow forecasting, initial values of the model parameter and covariance matrix of parameter estimate errors were evaluated by using the observed historical data of the hourly rainfall-unoff, and the accuracy and applicability of the models developed in this study were examined by the analysis of the 1-step ahead streamflow forecasts.