Complex Adaptive Systems Approach to Simulate the Sustainability of Water Resources and Urbanization

M. H. Giacomoni, M.ASCE[1]; L. Kanta, Ph.D., M.ASCE[2]; and E. M. Zechman, Ph.D., M.ASC

Abstract: Urban water resourc
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Hydrologic Footprint Residence: Environmentally Friendly Criteria for Best Management Practices

Marcio H. Giacomoni, S.M.ASCE[1]; Emily M. Zechman, M.ASCE[2]; and Kelly Brumbelow, M.ASC

Abstract: The natural hydrologic flow regime is altered by urbanization, which can be mitigated th
or low impact development (LID). Typically, the effectiveness of
velopment instantaneous peak flow

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Multiobjective Genetic Optimization Approach to Identify Pipe Segment Replacements and Inline Storages to Reduce Sanitary Sewer Overflows

Olufunso Ogidan[1] · Marcio Giacomoni[2]

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Abstract Sanitary sewer overflows (SSOs) is the unintentional discharg
sewage from the sanitary sewer system and pose serious risk to public
the environment. Rehabilitation plans to reduce SSOs involve increasing
capacity and shaving peak flow using detention storages. Identifying the l
for rehabilitating the sanitary sewer network is a difficult task, be
length of sanitary sewer systems. This

Complex Adaptive Modeling Framework for Evaluating Adaptive Demand Management for Urban Water Resources Sustainability

M. H. Giacomoni, Ph.D., M.ASCE[1]; and F

Abstract: New water resources management methodologies are needed to a
resources. Adaptive water demand management strategies provide an app
nds by adapting flexibility to increasing stresses, such as d
f a complex adaptive system modeling fram
nulate land-use change, consun
plied to simulate the effect of d
surface wat

Hydrologic Footprint Residence: Environmentally Frie Criteria for Best Management Practices

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Complex Adaptive Systems Approach to Simulate the Sustainability of Water Resources and Urbanization

M. H. Giacomoni, M.ASCE[1]; L. Kanta, Ph.D., M.ASCE[2]; and E. M. Zechman, Ph.D., M.ASCE[3]

Abstract: Urban water resources should be managed to meet conflicting demands for environmental health, economic prosperity, and social equity for present and future generations. While the sustainability of water resources can depend on dynamic interactions among natural, social, and infrastructure systems, typical water resource planning and management approaches are based on methodologies that ignore feedbacks and adaptations among these systems. This research develops and demonstrates a new complex adaptive systems approach to model the dynamic interactions among population growth, land-use change, the hydrologic cycle, residential water use, and interbasin transfers. Agent-based and cellular automaton models, representing consumers and policymakers who make land- and water-use decisions, are coupled with hydrologic urbanization and the water supply system over a long-term decisions of individual residents can significantly influence the water use and land use of consumers as the availability abilities to increase the sustainability of the water supply

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Urban development; Simulation.

ement; Urbanization; Sociotechnical

Enhancing the Performance of a Multiobjective Evolutionary Algorithm for Sanitary Sewer Overflow Reduction

Olufunso S. Ogidan, S.M.ASCE[1]; and Marcio Giacomoni, A.M.ASCE[2]

Abstract: The application of multiobjective evolutionary algorithms (MOEAs) to sanitary sewer overflow (SSO) optimization problems typically requires multiple runs of a simulation model and can be very computationally expensive. There is a need for simulation-optimization models that use fewer functional evaluations of the hydraulic model to identify near optimal solutions. In this study, two conflicting objectives were analyzed: maximizing SSO reduction and minimizing rehabilitation cost. This paper introduces a novel MOEA, the enhanced non-dominated sorting evolution strategy (*e*NSES) that uses a specialized operator to guide the algorithm toward known SSOs locations. This strategy is being tested in an existing network in the eastern San Antonio Water System network. It has been compared with NSGA-II and NSES based on hypervolume and the overall nondominated vector generation ratio (ONVGR). The results show that *e*NSES improves the convergence rate by approximately 70% over the tested alternative algorithms, performing as well as NSGA-II and outperforming NSES in terms of the hypervolume by nearly 10%. In terms of the ONVGR, *e*NSES performed similarly to NSES but outperformed NSGA-II by 42%.

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social, natural, and infrastructure
Yang et al. 2009). For these systems,
e approximated based on the simple
nce of separate elements.
modeling approaches have a long his-
ation for studying and analyzing water
tools can be applied to study urban
y. Simonovic (2000) identified two
radigm and the uncertainty paradigm,
e course of simulation approaches for
ater management. The complexity
that water problems in the future will
need to consider domains that were
nal to a rational system approach.
rations, including environmental and
growth and an increasing need for
water quality indicators, and longer
onal water resource systems analysis
set of methods that simulate diverse
el consumer behaviors as exog-
ily available

et al. 2012). Crossover involves the partial exchange of genes be-
tween two parent strings to form two offspring strings (Simpson et al.
1994). The use of the crossover operator in sewer system optimiza-
in a random search that does not reflect the feasible
ologically connected sewer net-
time. For ex-