User Manual for Storage Simulation Construction Set

Anil Sehgal and Richard A. Volz
Computer Science Department
Texas A&M University

Edited by
Angela L. Woods
Technical Editor
AMARILLO NATIONAL RESOURCE CENTER FOR PLUTONIUM/
A HIGHER EDUCATION CONSORTIUM

A Report

User Manual for
Storage Simulation Construction Set

Anil Sehgal and Dr. Richard Volz
Department of Computer Science
Texas A&M University
College Station, TX 77843

Submitted for publication to

ANRC Nuclear Program

April 1999
DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, make any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.
DISCLAIMER

Portions of this document may be illegible in electronic image products. Images are produced from the best available original document.
Abstract

The Storage Simulation Set (SSCS) is a tool for composing storage system models using Telegrip. It is an application written in C++ and motif. With this system, the models of a storage system can be composed rapidly and accurately. There are very aspects of the SSCS and are described within this report.
# TABLE OF CONTENTS

1. INTRODUCTION ............................................................................................................. 1  
   1.1 SSCS Overview ........................................................................................................ 1

2. FILE ORGANIZATION ................................................................................................... 3

3. SSCS USER-INTERFACE GUIDE ................................................................................... 5
LIST OF FIGURES

Figure 1: Directory Structure ........................................................................................................ 3
Figure 2: SSCS Main Menu .......................................................................................................... 5
Figure 3: New Vault Option Menu ................................................................................................ 6
Figure 4: Open Vault Dialog Box ................................................................................................. 7
Figure 5: Object Menu .................................................................................................................. 8
Figure 6: New Object Type Dialog Box ....................................................................................... 8
Figure 7: View/Delete Object Type Menu .................................................................................... 9
Figure 8: Create Object Dialog Menu .......................................................................................... 10
Figure 9: User Input Dialog Box ................................................................................................ 11
Figure 10: View/Delete Object Dialog Box .................................................................................. 11
Figure 11: Constraint Menu ........................................................................................................ 12
Figure 12: Creation of a Constraint ............................................................................................. 13
Figure 13: Subclass/Constraint Dialog Box ................................................................................ 14
Figure 14: Delete Constraint Dialog Box .................................................................................... 14
Figure 15: Constraints Present in a Currently Opened Vault ...................................................... 15
Figure 16: Dialog Box for Modifying or Viewing a Constraint .................................................. 15
Figure 17: Warning Message Dialog Box ................................................................................... 16
Figure 18: TGRIP Menu ............................................................................................................. 16
Figure 19: CLI Dialog Box ........................................................................................................... 17
1. INTRODUCTION
The Storage Simulation Construction Set (SSCS) is a tool for composing storage system models using Telegr. This document describes how to use the tool. The user should be familiar with the SSCS design document, which explains the terms and concepts in SSCS.

1.1 SSCS Overview
The SSCS is an application program written in C++ and motif. With SSCS the models of the storage system can be composed rapidly and accurately. Some of the highlights of SSCS are as follows:

- In SSCS, there is a library of graphical models of storage system components.
- Each graphical model is represented by a C++ class in SSCS.
- Each of the geometric models has some common attributes, such as location and orientation.
- Additional attributes or properties can be added to these geometric models with SSCS.
- Relationships between different geometric models can be defined.
- The relationships are expressed as a set of constraints, each of which is also a C++ class.
- New kinds of graphical models can be added to the library of the graphical models and these can be incorporated into SSCS.
- New constraints can be defined for any model.

The source code of SSCS consists of a number of files, which are organized in a directory structure. The file organization and directory structure of SSCS are explained in Section 2 of the report. Section 3 is a guide for using the SSCS interface. Appendix – A has the templates for adding the object and constraint sub-classes.
2. FILE ORGANIZATION

The file organization in SSCS is as follows. The top directory contains the source code for C++ files (.C) and the header files (.h) for object and constraint class definition. It also contains sscs.so, which is the shared object file (similar to a library) formed by linking all the object files. For starting Telegricp and SSCS the required environment variables are set by the script test.

There are 2 sub-directories named library and sub-class. The library sub-directory is the library of Telegricp geometric models. The sub-class directory contains the user-defined sub-classes for objects (in object sub-directory) and constraints (in constraint) sub-directory. Figure 1 shows the directory structure:

![Diagram of Directory Structure]

**Figure 1: Directory Structure**
3. SSCS USER-INTERFACE GUIDE

The SSCS can be started by running the script 'astest'. This script does the following:

1. Sets up the required paths for Telegrip library routines.
2. Starts the TELEGRIP.
3. Starts the SSCS.

The SSCS main menu is shown in Figure 2. This interface mainly consists of a menu-bar and a text area. The menu bar consists of the following menus:

(a) File Menu
(b) Object Menu
(c) Constraint Menu
(d) Tgrip Menu (Telegrip Menu)
(e) Help Menu

*File Menu:* This is a pull-down menu. When this menu is invoked by Left Mouse button, it displays the following four options:

- New Vault
- Open Vault
- Save Vault
- Quit SSCS

Figure 2: SSCS Main Menu
**New Vault:** This is for creating a new vault. When this button is selected the following dialog box appears for taking the user's input for the name of the vault being created and the path of the associated Telegrip workcell. After entering the name and the full path of the workcell, when 'ok' is pressed, a new workcell with the given name appears in Telegrip and a file called 'name.val' is created in the current directory, where 'name' is the name of the vault user the has created. Each SSCS vaults is represented by a file with extension 'val'.

The 'Clear' button is for clearing the text fields for the name and the Telegrip path of this dialog box.

The 'Cancel' button is for closing the dialog box without performing any operation.

**Open Vault:** This option is for opening an existing vault for modification or viewing. When this option is selected, a file selection dialog box is displayed. The user has to select the appropriate '.val' file, which represents the vault. When 'ok' is pressed, the vault gets loaded in SSCS and the corresponding workcell appears in Telegrip. The file selection dialog box is shown in Figure 4.

![Figure 3: New Vault Option Menu](image-url)
Figure 4: Open Vault Dialog Box

The ‘cancel’ button is for closing the dialog box without making any selection.

Save Vault: This button is for saving the opened vault. When pressed the current configuration of the vault is saved, and the corresponding workcell in Telegrip is also saved.

Quit SSCS: This button is for exiting from SSCS. When invoked, it closes both Telegrip and SSCS.

Object Menu: This menu is for carrying out operations related to objects and object types. This menu has the following options in the pull down menu:

- New Object Type
- Delete Object Type
- Create Object
- Delete Object
New Object Type: This is for populating the Telegrip’s library with new object types. For adding a new object type, the geometric model of the object has to be first created in Telegrip and saved in the library. When this button is pressed the dialog box shown in Figure 6 appears.

The user has to enter the name of the object type and the path of the associated geometric model in Telegrip’s library. The name of the object type should be same as the name of the file, which represents the geometric model of the object in Telegrip. When a new object type is created the object super class is instantiated and the instance is appended to the list of other object types, which are already present.

Delete Object Type: This option is for deleting an object type. When this button is selected the selection dialog box shown in Figure 7 appears.
On selecting the object type from the list and pressing 'ok', the object type is deleted.

**Create Object:** This option is for creating an object in a vault (a vault should be open before user can create an object). When this button is invoked the following dialog box appears which displays the list of object types available to the user.

![View/Delete Object Type Menu](image-url)
When a particular object type is selected and 'ok' is pressed, the dialog box shown in Figure 9 appears for getting the user's input. After entering the name of the object, its location and orientation, when 'ok' is pressed, the object is created in the Telegrisp's workcell.
Delete Object: This option is for deleting an object from a vault. When this button is pressed, the selection dialog box shown in Figure 10 appears which shows all the objects present in the particular vault.
When a particular object is selected and 'ok' is pressed, the object is deleted from the vault and also from the Telegrip's workcell.

**Constraint Menu:** This menu is for carrying out operations related with constraints. The user can create, delete, modify and check constraints. It has the following options:

- Delete Constraint
- Check Constraint

**New Simple Constraint:** This is for creating a new type of simple constraint. On selecting this option the dialog box in Figure 12 appears for taking the user's input.

New Simple Constraint
- New Specific Constraint
- Modify Constraint

![Constraint Menu](image)

**Figure 11:** Constraint Menu
Figure 12 shows the creation of a constraint, which represents the relation that the minimum distance between \texttt{rack1} and \texttt{rack2} is 20. For creating this, the following steps have to be followed.

- Enter the name of the constraint.
- Double click \texttt{rack1} (all the attributes of \texttt{rack1} will appear in the second window).
- Select \texttt{locY} attribute for \texttt{rack1} (it will appear in the text box below the window).
- Double click on \texttt{rack2} in the third window (all the attributes of \texttt{rack2} will appear in the fourth window).
- Select \texttt{locY} attribute of \texttt{rack2} (this will appear in the text box below the window).
- Enter the values of tolerances and the relation operator as \texttt{\textless;=} and 20.
- Press ‘ok’ button.

**New Specific Constraint:** This option is for creating a specific constraint (complex constraints). All such constraints are sub-classes of the super class ‘Constraint’. The C++ sub-class corresponding to the constraint should be written by the user as per the template provided in the Appendix – A. All sub-classes pertaining to constraints should be added in the directory ‘subclass/constraint’. When the user selects this option, the dialog box in Figure 13 appears.
The user has to select the constraint and press 'ok' to create the constraint.

**Delete Constraint:** This option is for deleting a particular constraint in the currently open vault. On selecting this option the following dialog box appears.

**Figure 13:** Subclass/Constraint Dialog Box

**Figure 14:** Delete Constraint Dialog Box
When a particular constraint is selected and ‘ok’ is pressed, the constraint is deleted from the vault.

Modify Constraint: This option is for modifying/viewing a particular constraint. When this option is selected the dialog box shown in Figure 15 appears, which shows the list of constraints present in the currently opened vault.

When a particular constraint is selected and ‘ok’ is depressed, the dialog box in Figure 16 appears for modifying or viewing the constraint.

After making the required changes to the constraint, when ok is pressed, the constraint gets modified.

![Figure 15: Constraints Present in a Currently Opened Vault](image)

![Figure 16: Dialog Box for Modifying or Viewing a Constraint](image)
**Check Constraint:** Constraints can be checked at any time while composing a model, by invoking 'Check Constraint'. When invoked, the user is displayed the warning messages regarding the constraints which are not satisfied. On pressing 'ok' the next constraint is checked and a warning message is displayed if the constraint is not satisfied. The dialog box in Figure 17 shows a warning message being displayed to user.

**Transfer to Tgrip:** For transferring the control to Telegrrip.

**CLI:** This is for sending a cli command to the Telegrrip. This may be helpful to user for providing some information about the details of model such as how many objects are present and their position/orientation. When this option is selected, the following dialog box appears.

**Tgrip Menu:** The Telegrrip menu shown in Figure 18 lists available options. CLI: For sending CLI commands to Telegrrip.

![Figure 17: Warning Message Dialog Box](image)

![Figure 18: Tgrip Menu](image)
When a command is entered and 'ok' is pressed, the command is executed and the control can be transferred to Telegrip's menu. After Telegrip's reply is displayed in the Text area of the main window, the control can be transferred back to SSCS menu by exiting from Telegrip's menu.

**Transfer to TGRIP:** While composing a model, if there is a need to change views or position/orientation of any object, the control can be transferred to Telegrip's menu. After making the required changes, the control can be transferred back to SSCS menu by exiting from Telegrip's menu.
Appendix A

Procedure for Adding a Sub-Class for Objects and Constraints
Appendix – A

This section explains the procedure for adding a sub-class for objects and constraints. All sub-classes for objects should be added in the directory ‘subclass/object.’ The template for writing the C++ sub-class (named SomeClass.C) has been provided in the following text. The sub-class can be created by making changes to the template. The necessary instructions are provided as comments in the respective templates. After the sub-class has been created, it should be compiled by typing ‘make’ in ‘subclass/object’ directory.

The sub-classes for constraints should be added in the directory ‘subclass/constraint’. The template for writing the constraint sub-class ‘SomeConstraint.C’ has been provided in the following text. Again the sub-class should be compiled by typing ‘make’ in ‘subclass/constraint’ directory.

// Filename : SomeClass.C

// Template for the object subclass
// We will refer to the subclass as "SomeClass"
// For writing a class from this template "SomeClass" has to be replaced
// by the actual class name. The file name should also be changed
// to the class name. Any class deriving from this class should be added
// in the directory /subclass/object

#include <iostream.h>
#include "../../objectSuper.h"

// This class inherits from class ObjectBase which is the super class

class SomeClass : public ObjectBase
{
    // declare the output operator as a friend
    friend ostream& operator<< (ostream&, SomeClass *);

    private:
        // Write all the attributes here. This class will inherit the attributes
        // location and orientation from the super class. All other
        // attributes should be declared here. In this template we will declare
        // the attributes as attribute1, attribute2, attribute3
        int attribute1;
        int attribute2;
        int attribute3;

    public:
        SomeClass() // default constructor
        {
            printf("SomeClass created\n");
        }

        SomeClass(ObjectBase& obj) // takes reference to the base class as
            : ObjectBase(obj) // argument and instantiates the object
        {
            // We assign the values to the attributes here.
            // In the template we have assigned values of 10 to all the
            // attributes
            attribute1 = 10;
            attribute2 = 10;
            attribute3 = 10;
        }

        virtual ~SomeClass() // Destructor
        {
        }
};
// This is for identifying the class type to make sure that the
// correct class is getting loaded
virtual void Show()
{
    printf("Show: I am SomeClass\n");
}

void Store(ostream& os) {  // This is for saving the class
    os << this;  // It should write its attributes to output
}

// Other Methods
ObjectBase *Rebuild(int , string[]);
string GetTypeObject(void);
string GetGeoModel(void);
string GetNameObject(void);
string *getAttributeName(void);
int GetAttribVal(string);
int GetAttributeNum(void);

};

// Factory class which is required for the dynamic loading of this class
// This is a sub-class of the ObjectFactory class
class SomeClassFactory : public ObjectFactory
{
    public:
        SomeClassFactory() // Default Constructor
        {
            printf("SomeClass Factory Created\n");
        }

        ~SomeClassFactory() // Destructor
        {
        }

        virtual ObjectBase *CreateObject() // This method is called while
        {
            // dynamic loading
            return new SomeClass;  // It returns a SomeClass object
        }
    
};

// The "C" linkage factory0() function creates the SomeClass class
// for this library

extern "C" void * factory0(void)
{
    return new SomeClassFactory;
}

// This method return the type of object
// The type of object is same as the Telegrip file name
// Let us say the Telegrip filename for this object is "some"
string SomeClass:::GetTypeObject(void)
{
    return "some";
}

// This Mehtod returns the full path of the Telegrip geometric
// model of the object that this class represents
// If the full path is /usr/sscs/library/PARTS/

string SomeClass::GetGeoModel(void)
{
    return "/usr/sscs/library/PARTS/";
}

// This method returns the name of the object

string SomeClass::GetNameObject(void)
{
    return nameObject;
}

// This method is for reconstructing the object
// When a saved vault is opened, this method is called which
// rebuilds the object and adds it to the list of objects in Vault

ObjectBase *SomeClass::Rebuild(int number, string list[])
{
    // Create a base class object
    ObjectBase *obj = new ObjectBase(list[0],list[1],list[2],atoi(list[3]),
    atoi(list[4]), atoi(list[5]), atoi(list[6]), atoi(list[7]),
    atoi(list[8]));
    // Instantiate this class
    SomeClass *class = new SomeClass(*obj);
    ObjectBase *retObj;
    // assign object of this class to a base class object and return
    retObj = class;
    return retObj;
}

// This method returns a list of names of all the attributes of this
// class the number of attributes in this case are 3(location)+3(orientation)
// +3 (of it own) so total is 9

string *SomeClass::GetAttributeName(void)
{
    // Allocate memory for the names
    static string attribs[9];
    for (int i=0; i<9; i++) {
        attribs[i] = new char[1024];
    }
    // Copy the common attributes
    strcpy(attribs[0],"locX");
    strcpy(attribs[1],"locY");
    strcpy(attribs[2],"locZ");
    strcpy(attribs[3],"orientX");
    strcpy(attribs[4],"orientY");
    strcpy(attribs[5],"orientZ");
    // Now copy the attributes of its own
    strcpy(attribs[6],"attributel");
    strcpy(attribs[7],"attribute2");
    strcpy(attribs[8],"attribute3");
    return attribs;
}

// Given a string this method return the value of the attribute

int SomeClass::GetAttribVal(string attrib)
{
// Check for common attributes
if(strcmp(attrib, "locX")==0)
  return locX;
else if(strcmp (attrib, "locY")==0)
  return locY;
else if (strcmp (attrib, "locZ") ==0)
  return locZ;
else if (strcmp(attrib, "orientX")==0)
  return orientX;
else if(strcmp(attrib,"orientY")==0)
  return orientY;
else if(strcmp (attrib, "orientZ") ==0)
  return orientZ;
// Check for its own attributes and return the values
else if(strcmp(attrib, "attribute1")==0)
  return attribute1;
else if(strcmp(attrib, "attribute2")==0)
  return attribute2;
else if(strcmp(attrib, "attribute3")==0)
  return attribute3;
// in case there is an error, return a large value
return 9999999;
}
// This method return the number of attributes(common and its own)
int SomeClass::getAttributeNum(void)
{
  return 9;
}
// This is for writing the object to the output, which is to a file in
// this case. Only the name of the class needs to be modified here
ostream& operator<<(ostream &os, SomeClass *obj) {
  os << "<" << "Object." << Class << "">
  << obj->GetGeoModel() << " ,"
  << obj->GetLocX() << " ," << obj->GetLocY() << " ,"
  << obj->GetLocZ() << " ," << obj->GetOrientX() << " ," <<
  << obj->GetOrientY() << " ," << obj->GetOrientZ() << " >> endl;
  return os;
}

// Filename SomeConstraint.C
// Template for a user defined constraint
// We will refer to the subclass as "SomeConstraint"
For writing a class from this template "SomeConstraint" should
be replaced by the actual class name (which is the name of the constraint)
The file name should also be same as the class name
Any class deriving from this class should be added in
the directory /subclass/constraint

#include <iostream.h>
#include "objectSuper.h"
#include "SscsVault.h"

extern Vault *thisVault;

This is a subclass of the class Constraint

class SomeConstraint : public Constraint
{
    // Declare the output operator as a friend of the class
    // so that it can access its attributes
    friend ostream& operator<(ostream&, SomeConstraint *);

    private:

    public:
        SomeConstraint() // Default constructor
            { printf("SomeConstraint created \n"); }
    // This constructor instantiates the base class and then
    // forms the sub class
    SomeConstraint(Constraint& con) : Constraint(con)
        { printf("SomeConstraint created \n"); }
    virtual -SomeConstraint() // Destructor
        { }
    virtual void Show() // Just for debugging to make sure that
        { // correct class is getting loaded
            printf("Con Show: SomeConstraint\n"); }
    void Store(ostream& os) // for storing the constraint
        { // in a file (when vault is saves)
            os << this;
        }
    Constraint *ReturnConstraint(void)
        { return this;
        }
    // Other method declarations
    Constraint *Rebuild(int, string[]);
    string GetNameConstraint(void);
    int GetNumArgConstraint(void);
    int IsSimple(void);
    int Check(Vault *);
};

// This is the factory class which is required for the
dynamic loading of this constraint class
// This is a sub-class of the class ConstraintFactory

class SomeConstraintFactory : public ConstraintFactory
{
public:
}
SomeConstraintFactory() // Default constructor
{
    printf("SomeConstraint Created\n");
}
~SpConstraintFactory() // Destructor
{
}
// Return an instance of SomeConstraint
virtual Constraint *CreateConstraint()
{
    return new SomeConstraint;
}

// the C linkage factory create the class for the library

extern "C" void * factoryO(void)
{
    return new SomeConstraintFactory;
}
// This method is for reconstructing the constraint object
// Let us say we have a constraint which expresses relation
// between three attributes. Let these object.attributes be
// object1.attribute1, object2.attribute2, object3.attribute3

Constraint *SomeConstraint::Rebuild(int num,string list[])
{
    assert(num == 1);
    assert(list[0] !=NULL);
    static string *sp_obj_list = (string *) malloc(10);
    static string *sp_att_list = (string *) malloc(10);
    static int *sp_tol_list = (int *) malloc(10);
    sp_obj_list[0] = CopyString("object1");
    sp_obj_list[1] = CopyString("object2");
    sp_obj_list[2] = CopyString("object3");
    sp_att_list[0] = CopyString("attribute1");
    sp_att_list[1] = CopyString("attribute2");
    sp_att_list[2] = CopyString("attribute3");
    sp_tol_list[0] = 0; // tolerance can also be defined if required
    sp_tol_list[1] = 0;
    sp_tol_list[2] = 0;

    // construct a constraint object
    Constraint *con_str = new Constraint("name_of_the_constraint",3,sp_obj_list,
    sp_att_list, sp_tol_list, "S");
    // construct a SomeConstraint object
    // assign the SomeConstraint object to a Constraint object and return it.
    SomeConstraint *new_con = new SomeConstraint(*con_str);
    Constraint *retCon = new_con;
    return retCon;
}

// Return the name of the constraint
string SomeConstraint:::GetNameConstraint(void)
{
    return constrName;
}

// return the number of arguments
int SomeConstraint::GetNumArgConstraint(void)
{
    return numArgs;
}

// This method returns 1 if it is a simple constraint 0 otherwise
int SomeConstraint::IsSimple(void)
{
    return 0;
}

// This is the check method which checks the constraint
// it returns 1 if the constraint is satisfied and 0 otherwise
int SomeConstraint::Check(Vault *temp)
{
    int rhs, lhs, val1, val2, val3;
    ObjectBase *oop1 = temp->returnObjRef(constrObj[0]);
    ObjectBase *oop2 = temp->returnObjRef(constrObj[1]);
    ObjectBase *oop3 = temp->returnObjRef(constrObj[2]);
    // if there are more than 3 attributes which have to be related
    // then add them here
    val1 = oop1->GetAttribVal(attrib[0]);
    val2 = oop2->GetAttribVal(attrib[1]);
    val3 = oop3->GetAttribVal(attrib[2]);
    // This is the check that has to be performed on the different
    // values of the attributes, we have just demonstrated a simple example
    if((val1 - val2) > val3)
    
        return 1; // return 1 if the constraint is satisfied
        return 0; // otherwise return 0
}

// This is for writing the constraint to the output operator
ostream & operator<<(ostream &os, SomeConstraint *con)
{
    os << "<" << "Constraint.SomeConstraint." << " >" << endl;
}