

The exporting of data from Visual3D requires an external database with a predefined data structure.

There are no restrictions as to which database system is used since connection to it is provided by ODBC connections. C-Motion's sample code is provided using Visual Basic for Application in Microsoft's Access database system.

The data structure is normalized to eliminate redundant data entry. The specific data values for signals, metrics, and analog data, however, are stored in a large single string that must be parsed prior to using the data for analysis purposes. This approach was necessary due to the inherent speed limitations a relational database has with storing tremendous amounts of data.

Note that some RDBMS systems may need add-on modules or extensions to support Transforms or Pivot Table capabilities. MS Access has the functionality built-in, so some example code provided by C-Motion may not transfer directly to other systems.)

The picture below illustrates the how the Visual3D signal and event tree structure maps to database tables. The Patient Info table is provided as a sample illustration on where the relationship to patient information may be managed. The BLOB table is where the raw data is stored after the exporting process is done, and a Raw Data table is provided for the parsed results. Sample database definitions and sample routines for parsing and managing data are provided by C-Motion.



Table Structure Definition

The actual SQL database tables loosely follow the Visual3D data tree layout, and are defined below:

TABLE NAME	DESCRIPTION	COLUMNS
L0_cmo	Contains the CMO file names.	cmoID = Integer, auto-incrementing index cmoName = Text PatientID = link to a patient table (optional)
L1_c3dfile	The C3D files contained in each CMO file.	fileID = Integer, auto-incrementing index cmoID = link to L0_cmo (foreign key) fileName = Text
L2_type	The signal or data TYPE in each C3D file. (Examples are: TARGET, EVENT, ANALOG, LINK_MODEL_BASED, etc.)	typeID = Integer, auto-incrementing index fileID = link to L1_c3dfile type_Name = Text (beware the "type" or "typename" may be reserved words in some RDBMS programs)

Signal Example

		eventID = Integer, auto-incrementing index fileID = link to L1_c3dfile event_label = text event_time = float description = text frame = integer
For a target signal called "LANK" we would see a row in the database for the signal name in L4_name table with a system generated ID called dnameID and a dataname. For example: 849 "LANK"	Events associated with a C3D file. It has event names, frame numbers, and timestamps. No tables link back to this one.	
L2_events		
In the L6_framedata table, we would then see the raw data associated with "LANK" represented as a row containing a system generated ID, the foreign key linking back to the L4_name table, and the data string. For example, for signal 849 (i.e. "LANK") we would see 10 frames of data like this:	The folder names holding signals for each type. (Example is ORIGINAL or PROCESSED.)	folderID = Integer, auto-incrementing index typeID = link to L2_type folderName = text
L3_folder		
2847 849 ^1@X@0.106221@Y@0.292641@Z@1.214349@Residual@0.000000@Camera bits@0.000000 ^2@X@0.106105@Y@0.292334@Z@1.214423@Residual@0.000000@Camera bits@0.000000 ^3@X@0.106008@Y@0.292041@Z@1.214490@Residual@0.000000@Camera bits@0.000000 ^4@X@0.105904@Y@0.291758@Z@1.214550@Residual@0.000000@Camera bits@0.000000 ^5@X@0.105815@Y@0.291485@Z@1.214604@Residual@0.000000@Camera bits@0.000000 ^6@X@0.105729@Y@0.291216@Z@1.214653@Residual@0.000000@Camera bits@0.000000 ^7@X@0.105646@Y@0.290950@Z@1.214699@Residual@0.000000@Camera bits@0.000000 ^8@X@0.105563@Y@0.290686@Z@1.214741@Residual@0.000000@Camera bits@0.000000 ^9@X@0.105480@Y@0.290420@Z@1.214782@Residual@0.000000@Camera bits@0.000000 ^10@X@0.105395@Y@0.290150@Z@1.214822@Residual@0.000000@Camera	Signal names in each folder, (but not the data)	signalID = link to L1_c3dfile dataName = text history = long text
L4_name		
L5_framedata	Each row has a label and a value for each motion capture frame. For example, frame 1 may have 3 rows for X, Y, and Z values. That is why a pivot table is needed for analysis purposes.	frameID = Integer, auto-incrementing index dnameID = link to L4_name frameNum = integer frameTime = float stepVal = integer (# dataValues per frame) label = text dataValue = float L6ID = Integer, auto-incrementing index dnameID = link to L4_name parsed = Boolean (optional yes/no indicator) bigdata = BLOB or long text
	This approach makes parsing the data fairly straightforward using the built-in parsing tools of today's programming languages. For example, in Visual Basic, using the Split command and Direct Access Object (DAO) methods for managing databases, the code to parse L6_framedata table would look like: One row per L4_row of consolidated data and labels stored as a BLOB (or large text string).	
Patient Dim Recset (OPTIONAL) Dim Frames (data definitions)	A sample patient table for linking to CMO's. The fields in the samples are derived from old VCM As DAO Records	VCM also has a Patient Codes cross-reference table.

Dim frameparts() As String

Sample SQL scripts to create this table structure are available for SQL Server, MySQL, and MS Access.

Dim frametime As Double

Dim i As Integer

Dim x As Integer

' Get the unparsed data signals

Set recset = CurrentDb.OpenRecordset _

("Select * from l6_framedata where parsed = False;", dbOpenDynaset)

Do While (Not recset.EOF)

The data exported from a C3D file into a database is too complex and dynamic for a rapid database transfer. The overhead associated with SQL insert commands is quite high, even with optimization.

Parse out the frames for this signal by the delimiter

frames = Split(recset.bigdata, "^")

For i = 1 To UBound(frames)

Parse out the data for the frame delimited by @

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        For x = 1 To UBound(frameparts) Step 2
            SQLstr = "INSERT into l5_framedata "
            SQLstr = SQLstr & " (dnameID, framenum, label, dataValue) VALUES "
            SQLstr = SQLstr & "(" & recset!dnameID & ", " &
frameparts(0)
            SQLstr = SQLstr & ", '" & frameparts(x) & "', " & frameparts(x+1)
            SQLstr = SQLstr & ");"
            DoCmd.RunSQL SQLstr
        Next
    Next
    recset.MoveNext
Loop
```

Note that this routine could potentially take a very long time to run since a SQL INSERT is performed for every component of every frame of data.

However, once parsed and inserted into the L5_framedata table, it is very easy and fast to access the data for analysis. This is where pivot tables play an important role. They permit the dynamic storage of data components to be managed since it is impossible to accommodate a data structure for every potential digital and analog motion capture related signal generator.

However, pivot tables can be avoided if only certain information, in a consistent format is needed, then new tables can be created to improve the speed of the parsing process.

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