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Version Control System (VCS) techniques for managing the creation of 3D computer generated models exist for static 3D models.

There are no solutions for revision control of the animation data from animated 3D models.

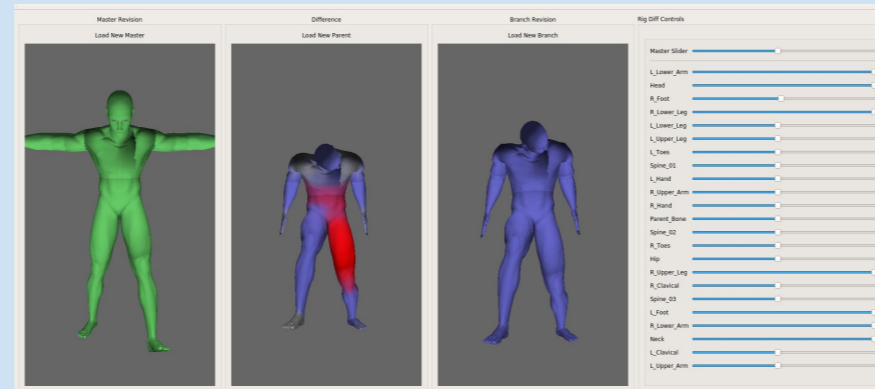
VCS's for data created by multiple users require two types of operations to exist as a precondition:

- A method to compare different versions of the data and to identify differences between them,
- A method for merging these different versions of the data in a meaningful manner.

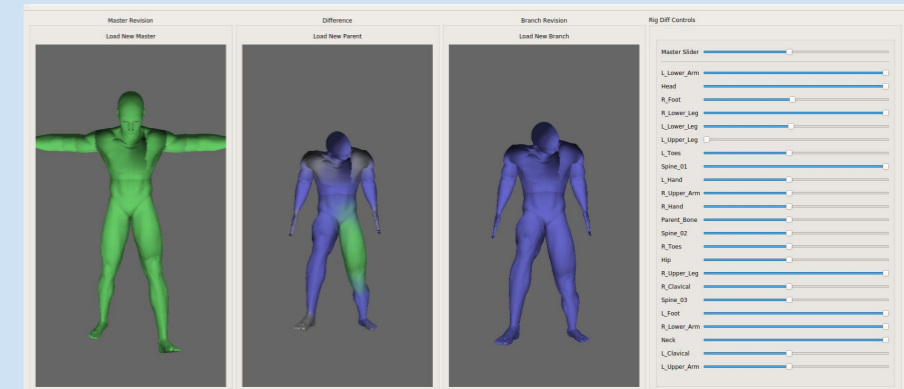
To this end, we propose a novel 3-way difference, merging and conflict resolution technique for 3D animation data that satisfies these criteria for a 3D animation data VCS.



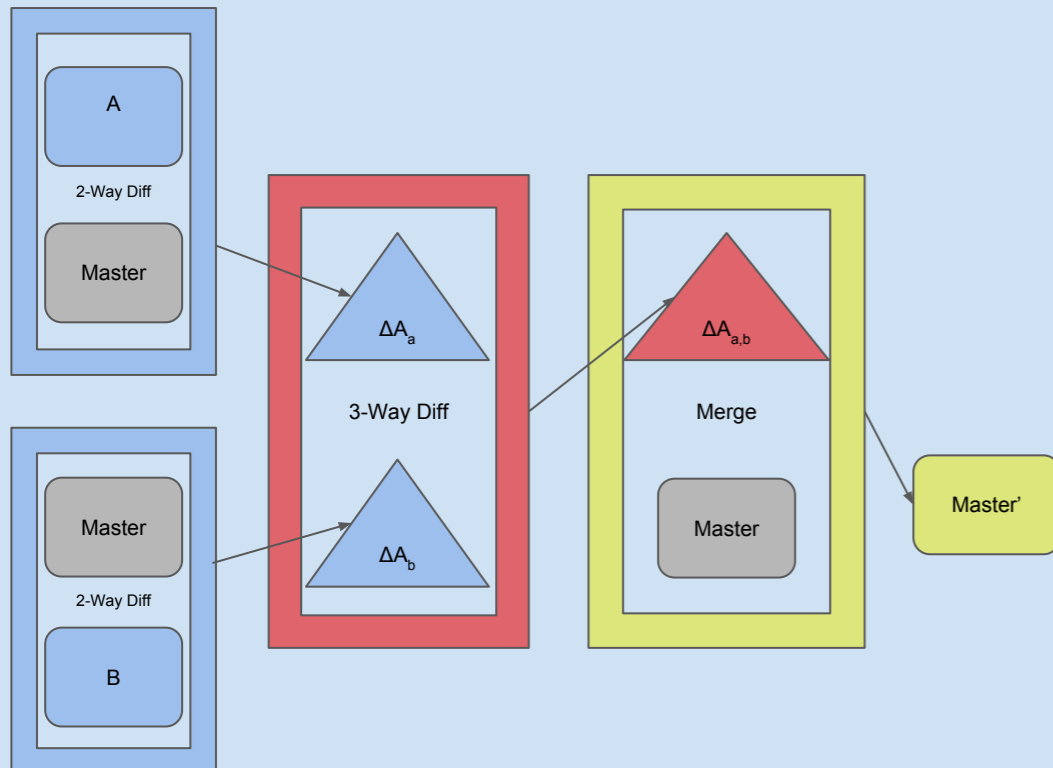
parent/master<sub>m</sub> animation (middle viewport) and revisions (branch<sub>a</sub> left viewport; branch<sub>b</sub> right viewport)



3-way difference between branches with merge conflict (highlighted in red in middle viewport) – shading denotes source



final merge result after (manual) conflict resolution (user selection)



### 2 Way Difference

To calculate the 2-way difference of master<sub>m</sub> and branch<sub>a</sub> animation:  
 $\Delta A = 2Way(A_m, A_a) = \{\Delta k_0, \Delta k_1, \dots, \Delta k_n\}$   
 we compare the difference kinematic hierarchy for each frame:  
 $\Delta k_i = \{\Delta j_0, \Delta j_1, \dots, \Delta j_n\}$   
 This requires identifying the differences between joint transformations:  
 $\Delta j_i = \{\Delta p, \Delta s, \Delta r\}$   
 This includes the differences for  
 Position:  $\Delta p = p_a - p_m$   
 Scale:  $\Delta s = s_a - s_m$   
 and Rotation:  $\Delta r = r_a * r_m^{-1}$

### 3 Way Difference

A 3-way difference involves a parent (master<sub>m</sub>) animation and two child animations (branch<sub>a</sub>, branch<sub>b</sub>):  
 $\Delta A_{a,b} = 3Way(A_m, A_a, A_b)$   
 We compare both sets of 2-way difference data, checking for cases where delta values of joint transformations are set in one branched revision and null in the other (XOR):  
 $\Delta A_{a,b} = \Delta A_a \oplus \Delta A_b$   
 Edit changes of both branches affecting the same joint at the same animation frame are registered as a conflict:  
**Conflict** =  $\Delta A_a \wedge \Delta A_b$   
 This may then have to be resolved manually by the user:  
 $\Delta A_{a,b} = (\Delta A_a \oplus \Delta A_b) \vee UserResolution(\Delta A_a \wedge \Delta A_b)$

### Merging

A useful mechanism in version control is the ability to merge two versions of an item descended from a common ancestor together into a new, blended version. By employing the 3-way difference data, we can apply the delta values to the master animation to produce a new merged animation:  
 $A' = A_m + \Delta A_{a,b}$