



Production

Basics of 3d animation and Rigging

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For successful and effective work in 3d rigging **Production** it is important to understand the basics of 3d animation process, mainly Rigging 3d characters. Production doesn't need to know all the details, but needs to know what it is and its building process.

While learning basics of 3d Animation and Rigging don't hesitate to search (google / youtube) online for any term which is not clear to you. For example by searching phrase "*Maya rigging*".

History

Computer graphics is fairly new discipline compared to other industries. It started around 1960's when automotive, aerospace and military found its use for design and visualization. Since then this industry was gradually developing and gained rapid pace in 1990's with mass production of CPUs (computer processing units / chips) and their cost started to fall to affordable level for commercial sectors and their performance rising exponentially.

With this wide use new companies like Adobe, Autodesk and others created new market of graphics commercial software for various industries.

By the end of 90's GPUs (graphics processing units) entered the hardware market with accelerating 3d graphics. This was also powered by fast growing game industry.

Let's watch a documentary narrated by Hollywood actor Tom Cruise. In six chapters it will guide you through the history of development of legendary visual effects and 3d animation studio Industrial Light & Magic (ILM). This studio was founded by George Lucas in 1975 for the purpose of making special and digital effects for StarWars movie. Their work can be also seen in blockbusters like Jurassic Park, Transformers, Pirates of the Caribbean or Marvel Avengers series.

Creating The Impossible Part I

<https://youtu.be/KTcE60KKRv4>

Creating The Impossible Part II

<https://youtu.be/XM5x-bkTcZQ>

Creating The Impossible Part III

<https://youtu.be/uuiLvtiMLwk>

Creating The Impossible Part IV

<https://youtu.be/JDkg0yAbem4>

Creating The Impossible Part V

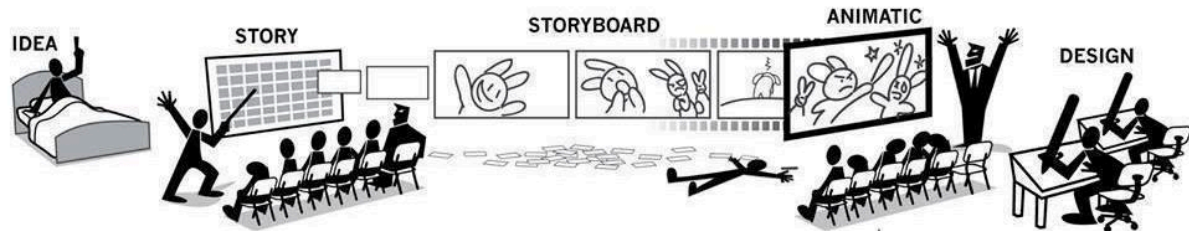
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Creating The Impossible Part VI

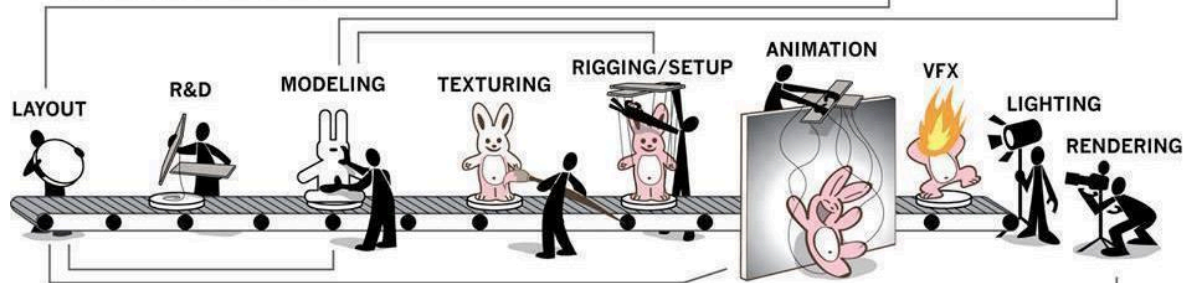
<https://youtu.be/XqEE8MTIG58>

Animation and VFX Production Pipeline

PRE-PRODUCTION



PRODUCTION



POST-PRODUCTION

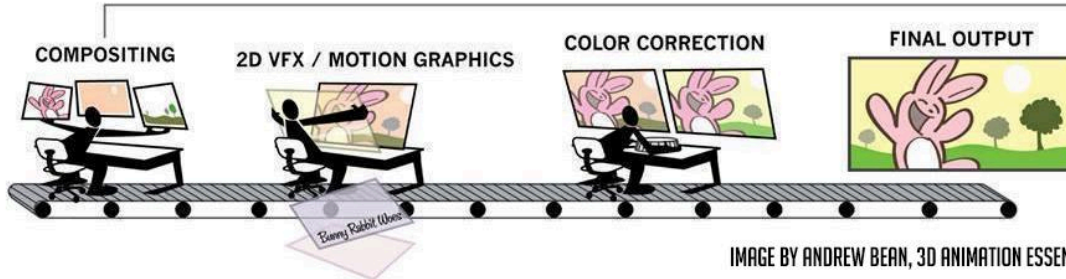


IMAGE BY ANDREW BEAN, 3D ANIMATION ESSENTIALS (2012)

3d Production Pipeline - full page:

<https://animeight.com/2018/02/21/3d-production-pipeline/>

Basics of Visual Effects and 3d Animation Disciplines by TheRookies:

 The_Rookie_Magazine_001.pdf

Process of 3d Animation by Disney:

<https://disneyanimation.com/process/>

Process of 3d Animation by Disney - Rigging:

<https://disneyanimation.com/process/?drawer=/process/rigging/>

What is Rigging?

▶ Rigging Fundamentals - What is a rigging? - by AntCgi

▶ Focus on Rigging with Tom Reed (MPC Head of Rigging) - by Tom Reed, Head of Characters (GhostVFX, former MPC)

▶ How Pixar's Movement Animation Became So Realistic | Movies Insider - by Pixar, based on Soul movie

[How to Animate Characters with Animation Rigging | Unity](#) - by Unity

3d animation and VFX disciplines

VFX Supervisor - leading role in CG animation and VFX. Communicates with film studio client and movie director to deliver his vision. Often goes on live action set and oversees preparing work for digital production.

CG Supervisor - reports to VFX Supervisor, focused on processing digital footage from set and leads CG team process. In mid to small size projects CG Supervisor is the top leading role, there is no VFX Supervisor.

Producer, Line Producer, Production Manager - various higher levels of Production. Takes care of deadlines, maintaining and updating budget, delivery schedule, disciplines schedule (modeling, animation, lighting work blocks etc.). Sometimes responsible for recruiting of artists and outsource.

Production Coordinator, Production Assistant - lower positions in Production. Serve on micro management basis - overseeing work of each 3d artist on schedule basis. Often focused on one department (e.g. just Modellers). Reports to higher Production levels.

Modeller - builds static 3d Model assets (environments, buildings, characters), sometimes blendShapes for character rigs. Uses software like ZBrush, Mudbox, Maya, Marmoset etc.

Texture artist - paints textures for 3d model shaders, combines real photo samples. Uses software Mari, Substance Painter, Zbrush, Marmoset etc.

Shader / Lookdev artist - makes shaders for 3d models. Lookdev means also development and testing in various light conditions using HDRI environment maps etc. based on required look of the character, prop or environment.

Groomer / Fur TD - makes hair and fur for humans, animals and sometimes feathers for birds based on 3d models. Software used: Maya XGen, Yeti, Houdini.

Rigger - builds animation and deformation rig armatures or puppets for animators - or just 'rigs' with controls, skeletons, muscles and sometimes simulation layers. Rigs are mostly built for Characters, Props and Vehicles. Software: Maya, MotionBuilder, UnrealEngine, Blender, 3dsMax.

Animator - animates character rigs. Sometimes builds shot layout placing rigs to shots or prepares and animates cameras. Often setting time range of each shot. Software same as Riggers: Maya, MotionBuilder, UnrealEngine, Blender, 3dsMax.

FX TD - builds simulation setups for anything based on real physics - cloth, natural elements (water, fire, fog etc.), destruction (explosion of buildings, cars etc.). Software: Houdini, Maya, Unreal Engine.

Lighter - puts 3d virtual lights into 3d scenes, often also sets up Rendering process (making image sequence from animation)

Compositor - works with rendered image sequence, often combining live action sequence and adjusts colors or contrast, adds various effects using masks or glows and flares and basically makes the final look of the image sequence. Software used: Nuke, Flame, After Effects, Fusion.

Rig Production Pipeline

This is simplified for production. Usually the rig is created in this order.

Model (not made by riggers) —> Skeleton —> Body Control Rig —> Face Control Rig —> Deformation Rig

Usually by **Body control rig** - it's understood that at least **quick skinning** is also done on Body rig (sometimes called Puppet) to get animation started as soon as possible. **Deformation rig** in the end can be just refining skinning or adding body correctives, helper joints, muscles or various types of skin deformers like sliding, relax, wrinkles, costume layer and overall focus on each geometry detail deformation.

Feedback

Almost no asset (model, rig etc.) is done or approved with the first version - "build it once" thing. There is the infamous feedback.

The more complex the asset is, the more feedback it usually gets. Asset versions in Pipeline exist to store this asset progress. Either because of feedback or simply to commit work in progress in various stages.

Feedback can be divided into categories:

- Fix - when something is obviously broken
- Technical - to meet brief or pipeline requirements
- Creative - changes coming from character design and story / animation script (basically it's difficult to plan everything ahead)

Also with higher 3d artist experience, there is less feedback. With less experienced artists there should be a Lead to check their work and help them navigate with best strategies to achieve the results in fastest way.

QC (quality control) before submitting (publishing) asset should be also in place to reduce amount of feedback.

Most used character Rig elements

- **Skeleton / Guide** - a combination of skeleton and rig build guide objects (curves, locators etc.)
- **Body rig** - control setup for the body that can be used by animators
- **Body skinning** - deformation binding between rig and character model
- **Muscles and Fat** - optional, used for volume preservation in various forms, from helping joints, to corrective blendShapes or anatomical muscle shapes and physical simulation setups. Most often applied on body. In some cases even on the neck and face.
- **Face rig** - control setup to animate the face expressions (skinning included).
- **Costume rig** - control and deformation setup for a separate layer or parts of costume (jacket, sleeves, collars, hoodie, coat etc.)

Non character rig types

- **Prop rig** - separate object rig, often held in hands of characters or in various interaction
- **Vehicle rig** - rig setup for car, tank, machinery, bicycle, plane, ship, spaceship etc.
- **Vegetation rig** - rig to animate plants, trees, leafs etc.
- **Environment rig** - rather rare type, ground deformation, rocks falling (to be later simulated on top) etc.

Rig setup types based on complexity

- From lowest to highest complexity
- 1. **Prop** (weapon, briefcase etc.) / **Vehicle**
- 2. **Biped Body**
- 3. **Quadruped Body**
- 4. **General Face**
- 5. **Costume / Complex robots or Armour costume with rigid parts / Anatomical Muscles**
- 6. **High detail realistic Face / Bird wings that can fold / Anatomical muscles with simulation setup** (fascia, fat, skin wrinkles) / **Extreme pose cartoon setups / Character Transformation** (one creature changing into another creature or extreme proportions change)

Rig Animation Tools

Rigs also can come with tools for animators. These are usually made by riggers who are authors of the rig systems, but often added by other riggers.

Most common are tools to change or set poses of controls that would be otherwise very difficult to set by animator.

Most common rig tools:

- IK / FK switch - match pose of arm or leg with IK or FK controls
- Space switch - match pose of control after switching to different space (body, hand, global etc.)
- Mirror / Flip Pose - mirror or flip pose of left and right controls sides
- Control Picker - 2d user interface to select controls or run other animator rig tools
- Velocity meter - display speed of animated object
- LOD switch - tool to replace rig of the same character for different level of details. Some rigs are so heavy or exist in larger numbers, that animators need to use lighter versions. Often in case of high detailed face and muscle rigs that are too slow to animate.

On some projects, riggers can be asked to build custom tools with UI to support rigs in Animation process.

Few examples:

- Shot based rig for selected objects - various soft deformation controls, or specific mechanical parts in Transformers robot type of projects
- Simulation to Animation - tools to run simulation on parts of rig, then “bake it” back into the rig, which can be animated on top of this result

Terms in Rigging and 3d Animation production

- **General**
 - **Asset** - static 3d element (e.g. Model, Rig, Textured Model, 3d environment)
 - **Version** - in relation to versions of work in progress on assets, animation etc. Artists should save their work incrementing with Versions “joe_model_v001”, “joe_model_v002” etc.
 - **Take** - term sometimes used for version of animations submitted by animators
 - **Naming convention** - rules how to name various objects or nodes like groups, parts of models, rig joints, controls etc. This depends on the current pipeline.
 - **Rendering** - process of generating 2d image or sequence of images from 3d scene
 - **Renderer / Render** - type of rendering system (e.g. Arnold, V-Ray, UnrealEngine)
 - **Software render** - non-realtime rendering system (Arnold, V-Ray, Redshift etc.)

- **Realtime / Hardware render** - realtime rendering system (UnrealEngine, Unity, Maya Viewport)
- **Texture** - 2d image map file used to give 3d object surface colors and details. Other textures are also used to adjust reflectivity or simple bumps or scratches without need to model them in 3d.
- **Shader / Material** - part of rendering system used to adjust appearance of a 3d object. Shader (or material) can make object look like plastic, metal, skin, wood etc. Shaders are using Texture maps and together make a look of model surface.
- **Displacement** - special type of shader. It can modify actual surface shape using 2d image file during render process where modeling would result in too much density of 3d model. This is used for small wrinkles on face, tree bark, leaf veins and similar subtle surface details.
- **Hero / Main Character** - main character, usually requiring more Model detail, more rig controls and highest quality
- **Secondary Character** - less important character then main, used in less shots or requiring less detail in Face and Body deformations.
- **Crowd / Background Character** - most simple character, usually not talking with basic or no face rig. Often there are many such characters, therefore Crowd type name is used.
- **Post-production** - usually means process in live action movies or commercials after live action part is finished and digital effects are added. This can be adding sci-fi city in the background, dragon flying into the shot or just changing colors of sky if shot was made during sunny day, but director needs darker atmosphere.
- **Storyboard** - story of animation put into drawings like a comic book
- **Animatic** - storyboard drawing put into motion. Usually very simple, but gives better idea of camera and character movement.
- **Previs** - very simple version of 3d animation or live action movie shots made with quick simple 3d models. Often used as a guide for final version with full quality effects. Previs often goes through many quick iterations based on director's ideas.
- **Postvis** - 3d elements quickly composited back into live action shots.
- **Cinematic** - higher quality polished movie style version of presenting a game, usually as a teaser / trailer for marketing purposes
- **Teaser** - short version of trailer showing upcoming movie or a game, usually still in production
- **Trailer** - longer version of a marketing video edit for upcoming movie or a game
- **Packshot** - shot in a commercial showing the product, often in its packaging look
- **TD** - technical director (e.g. Rigging TD, FX TD, Lighting TD)
- **CG** - computer graphics
- **CGI** - Computer-generated imagery, basically same as "CG"
- **UI** - user interface
- **QC** - quality control, usually performed before asset version is submitted to next department

- **AO** - ambient occlusion, simple system of making shadows based on proximity between objects surfaces
- **RGB** - computer color space made by combination of 3 colors: R - red, G - green, B - blue
- **XYZ** - 3 axis in 3d scene coordinate space: X, Y, Z
- **LOD** - level of detail. Used often for Models, but sometimes for Textures and Rigs Types. For example LOD0, LOD1, LOD2 or LODa, LODb etc. depending on naming conventions in every company.
- **Sup** - short name for Supervisor
- **WIP** - work in progress (used to describe status of asset versions that are presented / published but not finished yet)
- **EoD** - end of day
- **POC** - proof of concept
- **AAA** - usually used as mark of top quality game title project, similar to 5★ hotel ranking
- **ARG** - augmented reality game
- **VR** - virtual reality, basically a game-like realtime environment setup for stereo eye headset emerging a user to be fully surrounded by virtual world
- **Metaverse** - virtual world, working similar to a game with hundreds of users interacting in one environment. Recently also related to Web3 and NFTs, where users can own their avatars, items and even parts of this virtual land.
- **Game Engine** - software core of every game responsible for its realtime graphics
- **UE** - Unreal Engine, realtime game environment used today for more then just games. Unreal Engine is used for rendering animated series or cars visualisation.
- **Unity** - another game engine environment frequently used for game development.
- **L/R** - often used to abbreviate Left / Right side, when naming model parts of face blendShapes (morphs)
- **C/L/R** - same as L/R just including Central
- **Multithreading** - type of computing the rig using multiple computer threads on CPU resulting in higher speed.
- **Parallel evaluation** - another type of running the rig during animation using GPU unit. This also speeds up rig performance. GPU parallel computing is used for Rendering too.
- **Installment / Deposit / Fee** - term used for part of project payment divided in parts
- **end of play** - similar to EoD, time when team finishes their work that current day
- **w/c** - week commencing. Referring to a week which starts with certain date. For example: *"We will expect to receive the rig during w/c 7th October."*
- **TBC** - to be confirmed
- **TBD** - to be decided / to be delivered
- **ETA** - estimated time of arrival, basically estimate of when something will be done
- **TVC** - TV commercial
- **OMIT** - means task or shot was removed from production and everyone has to stop working on it immediately

- **Ballpark cost** - rough cost estimate for a project, usually with limited initial information, before getting more details, just idea about cost range
- **Greenlight** - state of projects or part of work when it's approved to start work
- **Live action** - portion of visual effects shot with real camera on film set
- **Digi double** - short for digital double, 3d animated realistic double of actor
- **Final edit** - finished version of sequence
- **Frame rate** - number of frames per second in animation or in gameplay
- **FPS** - frames per second (same as frame rate)
- **Scene** - usually means 3d file content with 3d scene. This can contain a model, rig, animation etc.
- **Origin** - center of 3d scene with zero coordinates 0,0,0
- **Zero plane** - floor level of 3d scene
- **Disney type animation** - a.k.a. Using 12 Principles of animation in 3d (more info here: <https://www.vectornator.io/blog/principles-of-animation/>)

● **Modeling**

- **Sculpting** - modeling work focused on form and shape. Sometimes it means keeping the same topology and only changing the shape or proportions.
- **Model** - 3d static scene with model objects composing a character, vehicle etc.
- **Mesh** - one model object, this term is used when discussing technical aspects
- **Geometry** - same as Mesh, one model object, this term is used when discussing technical aspects like structure, topology etc.
- **Topology** - structure of model mesh
- **Topo** - short version for Topology
- **Polygon** - one flat part of the model mesh structure
- **Face** - similar to Polygon, one flat part of the model mesh structure, but referring to a triangle segment
- **Vertex** - one point of the model mesh structure. Connected points (vertices) create a wireframe of a model geometry.
- **Edge** - connection line between 2 mesh points (vertices)
- **Quad topology** - mesh structure made of 4-sided polygons. This is the best quality. With exception of games, where triangles are ok or sometimes required.
- **Triangulated topology** - mesh with 3-sided polygons (or also Faces). Often used in game assets. For other non-game projects this is not the best choice. Because triangles are more difficult to work with in rendering and rigging.
- **Subdivide** - modeling process to increase number of points or polygons in mesh. Often this is done automatically in Rendering process to smooth the edges and increase final quality.
- **Subd** - short term for subdivision. Also used by riggers when the rig model is switched to higher or lower subdivision, smoothing out hard edges. This changes look of the model and sometimes removes / or shows intersection problems.
- **Polycount** - number of polygons in one mesh
- **Vertexcount** - sometimes used instead of polycount, just a bit different, number of vertices in one mesh

- **Model density / Model resolution** - amount of points in the model - not always exact number. Sometimes relative to project purpose. *"This is has too high density, can we reduce it?", "Can we increase resolution of the model around the face area because of closeup shots?"*.
- **Lowpoly** - low density mesh
- **Hipoly** - high density mesh (sometimes 'high poly')
- **Scan / hires scan** - high density model created by 3d scanning process from real object
- **Cleanup / Retopo / Retopology** - process of adjusting topology of usually scanned / hires model for rig-friendly work or Zbrush sculpting.
- **Optimised / Reduced / Proxy / Lowpoly** - various names for simplified model, mesh or its part - low poly is often used in Games
- **Wireframe** - geometry topology structure of the model
- **Shaded wireframe** - same as wireframe, but with visible model. So we cannot see through the wire structure.
- **UVs / UV map** - texture coordinates on the model. These are used for projecting 2d texture map image on the 3d model. This is basically a look-up system taking 2d coordinates from image space on 3d model.
- **Topology symmetry** - means when character model might have different shape on left and right side, but their topology structure on both sides is symmetrical.
- **Clashing names** - names of objects or their shapes are not unique in the scene. This common problem in Models, for example when objects are duplicated or mirrored to opposite side but their names stay the same, because they are under a group. Clashing names can cause problems in Rigging process and Animation tools. When they are called with 'short' name the tools can raise an error.

● Rigging

- **Biped** - humanoid rig structure
- **Quadruped** - animal 4-leg rig structure
- **World / Local position** - relative position of 3d object. Local means under coordinate space of another object.
- **Centre of world** - center of 3d space, zero position with coordinates 0,0,0 (XYZ)
- **Pivot** - point of position of every 3d object.
- **Parent** - object (control, joint, mesh) in rig or model hierarchy that has objects under itself
- **Orientation** - relative rotation of 3d object, joint etc.
- **Axis** - direction (vector) of 3d object, usually one of 3 XYZ axis
- **Rig / Rig setup / Setup / Rig build / Armature / Puppet / Rig asset** - all terms for 3d character rigs
- **Rig FPS** - rig frames per second is way of measuring Rig Performance or Rig Speed. How fast the rig moves. Ideal FPS of character rig is 15 FPS minimum. Great FPS is 24 or above which means basically realtime performance. If rig performance falls way below 10 FPS, riggers should make Optimised version -

often turning off some features like Face rig, Costume and Reduced density Model (proxy model).

- **Optimised / Proxy Rig** - various terms for fast optimized version of character rig. See Rig FPS for more info.
- **Cutup model** - model sometimes used in Optimized fast rig version. Based on rig skeleton, original character model is cut up to parts like wooden puppet. So rig can be faster with no deformations. These models are also often reduced to lower density.
- **Rig Evaluation** - refers to speed of computing the rig setup. Evaluation is process of computing all rig nodes in its network.
- **CPU** - basically core computing unit of computer (Central Processing Unit)
- **GPU** - graphics card processor (Graphics Processing Unit), in rigs often used for Parallel Evaluation.
- **Joint** - basic rig animation hierarchy object
- **Bone** - joint with length, usually end point joint. For example Shoulder joint ending with elbow joint is 1 bone. Shoulder - elbow - wrist is 2 bones.
- **Joint chain** - joints connected in chain. Often used in spine, tail etc.
- **Skeleton** - complete hierarchy of joints, usually representing full character
- **Controls** - icon shape objects in the rig which animators select and manipulate in order to animate the rig. They often look like colored curves.
- **IK** - inverse kinematics system allowing animator to move end point of leg or arm
- **FK** - forward kinematics system using hierarchy of parent and child controls or joints. So animators has to animate full chain to pose the arm, leg or spine.
- **IK / FK** - combination of both IK and FK in one rig, usually using switch or blend system to allow animators to use both in one rig.
- **Visibility Switch** - type of attribute in the rig to hide or unhide parts of character model (and sometimes its controls). For example character has 3 variations of costume. So we use Visibility Switch to only show one of them and let animator choose.
- **Skinning** - most basic deformation system which connects Skeleton and Model. Sometimes skinning means how well rig deforms model: *"Can you fix the skinning on shoulder?"*.
- **Weights / weight maps** - another word for skinning, related to weights of joints in Skinning to a model. Each vertex of model has its weight divided between skeleton joints.
- **Painting skin weights** - process of painting weights of skeleton joints on character model.
- **Constraint** - type of attaching model to a rig (joint) using model object transform, instead of skinning. Often used to attach high resolution and rigid objects to a rig, like a Robot or Vehicle.
- **Morph** - another word for blendShape, blending between shapes in one model
- **Cycle** - in rigging used for dependency evaluation error (e.g. "we are getting cycle when moving arm")
- **Sim** - term of dynamics simulation. For example hair or cloth simulation

- **ClothSim** - simulation of cloth. In rigging this is setup system for simulating the cloth.
- **Secondary dynamics** - another term for simulation setup. Often this can be simplified just adding some spring solver, not perfectly realistic.
- **Jiggle** - rig setup for spring dynamics applied on character skin or some soft parts of any model.
- **Fake collision** - simplified system to make objects look like they collide without any simulation. It usually has limits but works well for simple posing. Advantage is that no simulation is needed and it works realtime - interactive for animation.
- **Zero Pose** - reset pose of the Rig where all controls are in default value.
- **Bind Pose** - usually the same as Zero Pose. 'Bind' means that character model binds to Rig skeleton and setup in this pose.
- **Facing Z** - this means character (or vehicle etc.) is facing World Z positive axis direction, this is default requirement in Maya rigging
- **Intersection** - problem where model surfaces intersect. This can be caused in Model, but sometimes by deformation in the Rig.
- **Artifact** - or also 'deformation artifact' is a small broken or strange deformation of model in the rig
- **Vertex Spike / Stray vertex** - when a point in the mesh is left behind and makes unnatural spike shape. Can come from the original model, but also as result of bad rig skinning (or general deformation)
- **blendShape / shape** - usually Face rig setup part using sculpted shapes for different face expressions. But also can be used for any other model part. Shape is a single shape used in blendShape (in this context). Usually made by a Modeller, but some riggers have talent to sculpt them too. Sometimes face expression shapes are taken from actor scan and then cleaned up.
- **BS** - short term for blendShape
- **Corrective blendShape / shape** - a blendShape technique for fixing or improving a look of deformation area. For example elbow can use Corrective blendShape to make it look more sharp or closer to anatomy reference. These can be made by a modeler or a rigger who has skills to sculpt a nice shape.
- **Proxy mesh** - special geometry mesh that riggers make for easier deformation setup and other optimisations.
- **PSD** - Pose Space Deformation, system
- **FACS** - Facial Action Coding System, in 3d animation this means set of face shapes, each covering one specific muscle flex expression in human face. With full setup of these shapes, animator can combine them to achieve expressions. There are different levels of detail in FACS. One example is 52 shapes from Apple Face ARKit system, which is minimum but solid for nice results.
- **TR** - Translate / Rotate
- **TRS** - Translate / Rotate / Scale

- **Animation**

- **ROM (Range of Motion)** - animation sequence made to test the rig deformations in range of extreme poses. It can be Body ROM for body test or Face ROM for face test.
- **Mocap** - motion capture animation. Data is recorded from live actor or animal movement.
- **Performance capture** - motion capture recording of both Body and Face, sometimes just Face from a real actor
- **Face capture** - motion capture recording of real actor face
- **Keyframe** - manual technique of 3d animation, placing 'keyframes' in time on rig controls.
- **Stop-motion** - real puppet animation style, usually achieved by holding 2-3 frames static without computer interpolated movement between keyframes. This can be done as post-process. Most recently known from Laika animation movies (Coraline, Missing Link etc.)
- **Frame** - one point in time in 3d animation. For example animation can have 500 frames. If this frame rate is 25, then this would be $500/25 = 20$ seconds of animation.
- **Timeline** - range of animation frames in 3d scene
- **Scrubbing** - moving time slider in animation timeline either forward (timeline direction) or backwards (rewind - against timeline direction).
- **Reset frame** - this usually means frame in time where Rig Dynamics are reset. From this frame (or before) animation needs to start for dynamics to work properly.
- **PreRoll frames** - animation frames before start of actual animation shot used for simulation to "settle down" or get correct momentum
- **Layout** - adding all assets to the 3d animation scene. Just placing environment models and character rigs and static objects where they should be. Basically first phase of building 3d animation shot scene.
- **Blocking** - first raw animation. No details or fine tuning. Often using a work in progress rig version. This follows Layout stage.

Most used file formats

- **Model**
 - **OBJ** - most basic quite primitive type, but also most compatible
 - **FBX** - very often used, it can also hold skeleton, animation and blendShapes
 - **ZTL** - ZBrush native format
- **Animation**
 - **MA / MB** - Maya Ascii (text), Maya Binary

Animation Industry Websites

Articles from world of visual effects and games:

<https://www.fxguide.com/>

More articles from world of visual effects and games:

<https://www.artofvfx.com/>

Animation World Network - online magazine with news about 3d animation and VFX:

<https://www.awn.com/>

ArtStation - 3d and concept art community gallery and marketplace:

<https://www.artstation.com/>

Turbosquid - biggest marketplace with 3d models (rigged models included):

<https://www.turbosquid.com/>

CGTrader - second biggest marketplace with 3d models (rigged models included):

<https://www.cgtrader.com/>