

## INTRODUCTION:

Hello, welcome to this amazing google doc that gathers tutorials and resources for LIVE2D as well as some tips from myself haha yeeeeee

I originally made this google doc to help my friends learn live2d but I hope this can be useful to many people! Live2d is my passion and being able to pass on my love for it to other people would make me incredibly happy! I hope this can make your live2d journey lighter and more exciting!

I will be separating this in 3 main sections: vtuber model rigging, animation, and vtube studio.

But the rigging section will definitely be much bigger than the other sections since the rigging has a lot more things to learn.

In each section I will be sharing links to youtube tutorials. There will be a lot of them because I believe it is better to learn from multiple sources since everyone rigs differently, everyone has different tips and tricks to share. But I haven't seen them all myself, and you don't have to watch them all either. The ones that I personally saw and found useful will be at the top of each individual link list.

There are a lot of things to learn about live2d, but don't worry, take the time to digest things one by one, get better from each piece you complete and have fun!

Since there are so many informations, I believe it is better to skim through them quickly/roughly just so that you know in the back of your mind what can be done, but don't think about it too much because it's confusing. At some point you will need to use that information and that's when you will learn it for real.

Vtube studio is also included in this doc because even if it is not part of the vtuber rigging, I believe it is useful to know how your live2d parameters are translated into vtube studio and how they can be managed/customized. Having vtube studio knowledge before rigging will make it easier for you to know what to do in live2d. It is also an inevitable part of vtubing and you will have to learn how to use it one day or the other.

In this doc, I might not use the exact appropriate vocabulary (artmesh, vertices, etc) since I usually don't really care about it because I visually know what they are when I work on my own. But since I have to refer to them by words now, I will try my best to get the right vocabulary, or to refer to things using only one name throughout the whole doc.

Here's how I structured the sections:

## RIGGING:

- full process
- how to cut
- about meshing
- about physics
- eye rig

- mouth rig
- brow rig
- head angles
- head angles showcases (for reference)
- hair physics
- body angles
- glue tool
- augmented physics
- toggles
- how to rig other specific things
- other
- keyboard shortcuts
- my tips, troubles I encountered with solutions
- Vtuber model showcases (I love watching them, it's also a good reference for how to rig different type of characters and broaden your creativity range)

### ANIMATION:

- tutorials
- live2d animations (surprisingly there aren't **that** many live2d animations)

### VTUBE STUDIO:

- tutorials
- that's all, I haven't finished that section

Here is the **Live2d manual** > <https://docs.live2d.com/en/cubism-editor-manual/top/>  
 Same here, it's good to skim through it. The most important parts are the "**modeling**" and "**animation**" section. It's super useful especially for better understanding the tools in a way that tutorials don't explain.

One time I erased a preset for automatic meshing by mistake, so I went to the manual which gave the original numbers for the default presets. So it can be useful in that way as well. Also, if you know a bit about physics, the numbers can be quite confusing and tutorials don't really explain them individually, they just say to play with them until it looks right. So I recommend looking into the manual to understand it better.

## RIGGING:

When it comes to starting your first vtuber model, I think it's better to follow one main guide + additional tutorials for some specific parts. The best one that I've seen is Chupuko's step by step guide. It's very good because it's easy to follow, short and clear. Here's the guide > [https://youtube.com/playlist?list=PLs1M2\\_VbQOf6bDLan8j-Tr7R-k9VDo3Pi&si=6e6K8wBjD0eyWtgc](https://youtube.com/playlist?list=PLs1M2_VbQOf6bDLan8j-Tr7R-k9VDo3Pi&si=6e6K8wBjD0eyWtgc)

I know that another rigger I really like (Merely.wufei) made a guide, but I haven't watched it enough to know how good it is >

[https://youtube.com/playlist?list=PLVr9R5AakwuT4wgxFr5mcv0As\\_OzR\\_WCB&si=7t4o7GBFWgeaWa13](https://youtube.com/playlist?list=PLVr9R5AakwuT4wgxFr5mcv0As_OzR_WCB&si=7t4o7GBFWgeaWa13)

In my opinion, Chupuko's guide is made specifically and is perfect for novices/beginners. And Merely.wufei is a very impressive rigger who has more advanced knowledge to share.

**Full process videos:** (I actually haven't watched any of them)

- <https://youtu.be/46qvSVPsalk?si=q9bRRTiGD--TtYJU>
- <https://youtu.be/E6s6YqI7HsY?si=8GutL8T9fjPjBj4z>
- <https://youtu.be/WyOgru2MQ24?si=MKSJEDreoUtlefN->
- <https://youtu.be/P8URGR9oeMg?si=j0SZOuc0IRTKCHU7>
- [https://youtu.be/x5xrpKukaUI?si=\\_YDPt1ZozVIOwl1D](https://youtu.be/x5xrpKukaUI?si=_YDPt1ZozVIOwl1D)
- <https://youtu.be/VA5nQqIOUmk?si=b6Wfuh11vRhsY2up>

**Cutting:** (I don't remember watching any of those either)

- <https://youtu.be/rhDTAilcyxU?si=wdNBYJvS2OdVW2Dh>
- [https://youtu.be/FS5FY\\_NWXSx?si=mv5pWafOBKcpSonK](https://youtu.be/FS5FY_NWXSx?si=mv5pWafOBKcpSonK)
- <https://youtu.be/ieiioJaznXc?si=mTAHyb4DjeBOA-MI>
- [https://youtu.be/FwQBCzx\\_BM4?si=4rKpME6zNNdbiWPa](https://youtu.be/FwQBCzx_BM4?si=4rKpME6zNNdbiWPa)
- <https://youtu.be/PS0TvbNgoqo?si=i6v4VRh6GF4m5N4I>
- eyes > <https://youtu.be/uc5h-fXCTmQ?si=l90m9v55QtmJqZtX>
- head > <https://youtu.be/sTEQ-CBXt1I?si=zXUvksEhsbt2W0g8>

The more you separate parts, the more detailed your rigging can be. It's easy to do but it just takes quite some time.

Depending on your drawing process, you might have a different way of cutting. You can either draw element by element on top of your sketch, so that everything is separated from the get go, or draw everything and then cut later. Personally, my usual drawing process is sketch > color > render. So I prefer to cut everything at the end. But I like to separate big elements from the get go: Hair, face, head, body. At the end I cut everything into smaller details.

**How I cut:** I take the lasso tool and copy paste each element from the most front to most behind element. Then for each element, I erase the excess and if necessary redraw parts that were originally hidden behind other elements.

**About lineart,** there are 3 ways it can go:

1. you have the lineart separated from the base color and shading (makes it easier to make a 3d look because you can move the whole shading (which should be clipped to the base color) without worrying about the lineart)
2. the lineart is not a line but is basically the same shape as the element it is from, but bigger, and is placed behind it. I saw it from this video (8:25) > <https://youtu.be/AM-DYj0d5vo?si=wUKJsDLuphaY9NG>
3. Everything is merged into one layer (lineart, base color, shading). For an example, you can watch the same video starting from 5:11.

I mostly do number 3 but sometimes do number 1 like for the face, or when I plan to make it look 3d, but the shading is too close to the lineart, so it's easier to separate it.

For the head, there are two things you might want to think about:

1. Some people like to use a mask so that when the head looks up, the head lineart disappears around the neck.
2. Some people like to add an outer shadow layer that is basically the same shape as the base for the head but inverted, to make it look more 3d.

If you want to do one of the two, then you will have to separate the lineart for the head.

### About meshing:

This whole part is super complicated to explain for such a simple thing.

So in live2d, layers are called artmeshes. To be able to deform them properly, you have to mesh those artmeshes, by putting vertices(points) connected by lines on them. The more vertices there are, the more detailed and smoother your deformation can be, but it will also be heavier and harder to deform smoothly.

If a part of the artmesh is not inside the mesh, that part won't show up anymore. It's useful to get rid of stray dots.

Meshes can be modified at any time, so don't worry about getting it right from the beginning.

In my opinion, you don't really have to care much about it, just slap a preset and modify it later if necessary (usually for small elements and details)

Try to make the mesh close to the border of the artmesh, because if you make it bigger, it will take more space in the texture atlas(which will make the model file heavier)

If you see that an artmesh is not getting deformed correctly, it might mean that your deformer does not have enough divisions, you might have forgotten to mesh your artmesh, or your artmesh needs a more detailed mesh.

When moving points of a deformer, you're also moving the vertices of the artmesh under it. If there are no vertices under it, the artmesh won't move. Same for the other way around, if your mesh has a lot of vertices but your deformer barely has any divisions, the deformations will still be very blocky. (If you're confused by the wording, I can call and explain to you visually instead (so about calling, I was originally talking to my friends, but if you're in my discord server I can also do that!))

### About physics:

physics manual page >

<https://docs.live2d.com/en/cubism-editor-manual/physics-operation/>

From my understanding, physics are for a movement that is caused by another movement. For example, hair moves because the head moves.

If you want to add physics to an element, you should always have a minimum of 2 parameters for that. 1 parameter won't make a good movement that flows naturally

(but that's just how I feel and I might need to verify that because there might be exceptions like augmented physics).

Because physics needs a lot of trial and error, you can check if the movement looks good before going to the physics settings, by **linking** your 2 parameters and moving them in a circle or an oval.

In the physics settings, you can set the input type as either **angle** or **position**.

Using hair as example, from my understanding:

- **Position:** is when the head moves, the hair swings, then comes back to its original position (stops swinging)
- **Angle:** is when the head rotates, the hair follows the rotation. It will only come back to its original position when the head comes back to its original position.

You'll see that when you set angle z as an input, the type is automatically set as angle, since angle z is the rotation of the head.

To clarify what input and output are, like I said before, it's a movement caused by another movement. When parameters set as input move, the parameters set as output are caused to move.

Also, when doing physics, looking at the movement of the dots of the parameter helps a lot to see if it's flowing well with each other or if you need to correct the numbers.

Another thing, when you want to increase the outputs, make sure that first you have moved the parameter that was set as input. Or else the numbers won't increase much.

#### Eye rig:

- Chupuko > [https://youtu.be/NdU4aZOu-cA?si=qNcVDdfe\\_GK3fHi6](https://youtu.be/NdU4aZOu-cA?si=qNcVDdfe_GK3fHi6)
- Merely.wufei > <https://youtu.be/KrrH8hJ93iU?si=yNLvWJMupJCThYYL>
- Merely.wufei > [https://youtu.be/Ct7Jb\\_q\\_Hul?si=4MRkl4qyqMkdoKv](https://youtu.be/Ct7Jb_q_Hul?si=4MRkl4qyqMkdoKv)
- Cat Athenya > <https://youtu.be/7kicnYfWNc8?si=CsuY9cu1SwmW-M4V>
- Cat Athenya > [https://youtu.be/hs\\_DINKodgY?si=kngm9aE3MirDT6Wd](https://youtu.be/hs_DINKodgY?si=kngm9aE3MirDT6Wd)
- Dinahsour > <https://youtu.be/-S-TDPI8hdU?si=Exyxu1RacecSxEDM>
- [https://youtu.be/ofqXSQjb\\_lw?si=fPX-po0qY1JyU5Bn](https://youtu.be/ofqXSQjb_lw?si=fPX-po0qY1JyU5Bn) (showcase)
- [https://youtu.be/-CnkD-K8N6Y?si=6eSWnHFb7R\\_BhPxX](https://youtu.be/-CnkD-K8N6Y?si=6eSWnHFb7R_BhPxX) (workflow)
- <https://youtu.be/7n6dTH7SCxg?si=Ycyfp4rmBwGkrhqC> (workflow)
- <https://youtu.be/aOb45GCDnG8?si=d-3l-X0lA-u0rcM0> (workflow)

#### Mouth rig:

- Chupuko > <https://youtu.be/2H3xgBoypqA?si=SnbvYCSCO-pK842M>
- Kira Omori > [https://youtu.be/tJdS1G5ybkE?si=Kfennu6bkSRwMr\\_H](https://youtu.be/tJdS1G5ybkE?si=Kfennu6bkSRwMr_H)
- Cat Athenya > [https://youtu.be/-atRql2wei8?si=1ivKcID\\_B7lei\\_5Y](https://youtu.be/-atRql2wei8?si=1ivKcID_B7lei_5Y)
- Merely.wufei > [https://youtu.be/O-ztKGn6dtE?si=YCNG\\_IQqJsqGaYE9](https://youtu.be/O-ztKGn6dtE?si=YCNG_IQqJsqGaYE9)
- Cutie Dragon > <https://youtu.be/ZetZLxud7L0?si=EzkK4rLPpmRiv2Db>
- Grape > <https://youtu.be/whRGM7LCXhk?si=NlmqgmplYEWLaxyT>
- MeiiArt > [https://youtu.be/83xnp6y7WAI?si=bOtF1oyXAzHx\\_3ZS](https://youtu.be/83xnp6y7WAI?si=bOtF1oyXAzHx_3ZS)
- <https://youtu.be/AW45Pmc5gqc?si=e4LEH0WEliX2icaG> (workflow)

Basically, for **mouth form**, at 0 it's the neutral expression, 1 is happy and -1 is disgusted/angry/unhappy.

Then for the **mouth open**, 0 is closed, 1 is open. So you just need to rig it open at 1 for all mouth forms, and then make sure the movement looks good by rigging the in-between.

If I remember correctly, Chupuko's explanation and chart was slightly more complicated (but still easy) so I hope this can make things more understandable.

Cat Athenia's mouth rig is very interesting because it's actually trying to **mouth vowels**. She also linked in comment a chart for reference >

<https://x.com/ramdroidrigs/status/1552020285229920256?t=8E3FOZhOiXeJ2qJcy6TBIQ&s=19>

The chart shows vtube studio's mic tracking settings alongside so I think that's even more interesting.

#### Brow rig:

- [https://youtu.be/yzx\\_qLJgPzE?si=3hhjR9N0b-dUWMgm](https://youtu.be/yzx_qLJgPzE?si=3hhjR9N0b-dUWMgm)
- <https://youtu.be/l0NOUdn8bmY?si=0jg4VtOKrCkeqlcc>

#### Head angles:

- chupuko > [https://youtu.be/1pFJuldwlOQ?si=oiPj90p9jd6FpNR\\_](https://youtu.be/1pFJuldwlOQ?si=oiPj90p9jd6FpNR_)
- Kira Omori > [https://youtu.be/9UtgbWB5CKs?si=BwiMPsf\\_3NqvUxL1](https://youtu.be/9UtgbWB5CKs?si=BwiMPsf_3NqvUxL1)
- Merely.wufei > [https://youtu.be/ipH\\_yYMwJgY?si=Sc4jP3jMG0Six0B](https://youtu.be/ipH_yYMwJgY?si=Sc4jP3jMG0Six0B)
- 180° head turn > [https://youtu.be/-mLVKeRwuZk?si=pe2\\_MMuM5VuLxVVr](https://youtu.be/-mLVKeRwuZk?si=pe2_MMuM5VuLxVVr)
- Fennryn > [https://youtu.be/RF\\_QupbfiQw?si=mp7uPog7oUR4T4-S](https://youtu.be/RF_QupbfiQw?si=mp7uPog7oUR4T4-S)
- invisible lineart > <https://youtu.be/p1MV6FauGz8?si=cJyPR4QAT-HxzWmN>
- <https://youtu.be/h3pKML6vGPK?si=U50bzySTGWpNadI3> (workflow)

Make sure to rig the head as a **3d object** like a ball or a balloon! If you rig it like a mask instead it **flattens** the head in the majority of cases.

Chupuko covers **augmented physics** in her tutorial, you can see more videos about it in another section below!

Now, I'm gonna talk about **parent-child hierarchy**, which is a more advanced notion and might be confusing, but in Kira Omori's tutorial, you can see that if the parent has keyforms rigged on a parameter, by adding keyforms to the child on the same parameter, it will also take on the rig that you made on the parent. Which means you can now **delete the parent** with no problem because the child retains all the rigging. It can help to reduce the number of deformer (If you don't have the pro version, there is a limit for deformer) but it also helps if you have problems with the hierarchy.

#### Head angles showcases:

- [https://youtu.be/BANPq\\_qBgY?si=ash1CrbhJED8ksXS](https://youtu.be/BANPq_qBgY?si=ash1CrbhJED8ksXS)
- <https://youtu.be/1cdRm3FU-Rg?si=XYO3UBAJu1ILTsfX>
- [https://youtu.be/JiUWcG8rR\\_l?si=OAyywTmf2S3QsXZW](https://youtu.be/JiUWcG8rR_l?si=OAyywTmf2S3QsXZW)
- with hair > [https://youtube.com/shorts/JZSIUDYyEZA?si=Cqqt-gz80XFIS\\_mZ](https://youtube.com/shorts/JZSIUDYyEZA?si=Cqqt-gz80XFIS_mZ)
- with hair > [https://youtube.com/shorts/PgPaL3nelss?si=4xeHciAH812v99\\_2](https://youtube.com/shorts/PgPaL3nelss?si=4xeHciAH812v99_2)

### Hair physics:

- Chupuko > <https://youtu.be/i8RIZr8Xd00?si=iv6xh9h4NZPWPzf7>
- Kira Omori > [https://youtu.be/kTbhZQ7AVwg?si=dGkpe8vF\\_4uG4Ro4](https://youtu.be/kTbhZQ7AVwg?si=dGkpe8vF_4uG4Ro4) (+ boobas at 2:30)
- Shiromi > <https://youtu.be/fITPG6sHI0g?si=Q9uaTDD2WEcC3Bqr>
- Uparuna > [https://youtu.be/ySdge\\_XC40Y?si=BHOpecP7a8gDCe6i](https://youtu.be/ySdge_XC40Y?si=BHOpecP7a8gDCe6i)
- Kuroama > <https://youtube.com/shorts/mBlceyWrpOs?si=usy21vy6MT666Ymu>
- Bell > <https://youtu.be/X4SPm-swLNg?si=6tetUfQwUNHtTRv->

Chupuko talks about multiple methods. The one I use is method 4.

She also talks about **extended interpolation** towards the end, so try to remember that because I totally overlooked that and only learned about it recently from another video. It's terrible because without it, instead of swinging smoothly, it's gonna look laggy. If the swinging looks bad, I usually start with 1 point for the extended interpolation. If the issue is not resolved I increase points, but don't add more than necessary because it will be heavier.

### Body angles:

- Chupuko > <https://youtu.be/Krwh90iZSMI?si=FMOv4Llog2LwEvvQ>
- Merely.wufei > [https://youtu.be/Sie36dd1Q7Q?si=SIJWOMLue0TRM3\\_A](https://youtu.be/Sie36dd1Q7Q?si=SIJWOMLue0TRM3_A)
- Vyris2D > <https://youtu.be/l-GTExhIRjQ?si=yfhlUeT3zenT9Wo3>
- <https://youtu.be/VzKfIJad5Z4?si=LkC7cn0HsNs7luFb> (workflow)
- Leg rigging > <https://youtu.be/1Pw2KsQbVT0?si=wyWHv6kIMVlvKP2L>
- sidestep > <https://youtu.be/jFdxpGTQSig?si=t5leLE54LQYfDQzN>
- arms > <https://youtu.be/UusoqHY9RkM?si=uJdYtR6lccejRJWT>

The workflow video taught me that there is a way to temporarily change the center of your selection(around 21:50), which gives better control when you want to rotate it (they use it for the legs in the video). After looking into the manual, I learned that you just have to press x to do it.

### Glue tool:

- [https://youtu.be/PEtBdsGqNn4?si=-t7\\_xObgx4OtFL8Y](https://youtu.be/PEtBdsGqNn4?si=-t7_xObgx4OtFL8Y)
- <https://youtu.be/k4HvMYN714E?si=iPn0DTUf1UdAsRho>
- mouth glue > [https://youtu.be/ushLCTEdp\\_A?si=DmgA2uP0vF-KPRCg](https://youtu.be/ushLCTEdp_A?si=DmgA2uP0vF-KPRCg)

A tool that I'm not particularly fond of. I don't really use it but might learn it one day anyway because it can make my life easier if I learn it \_(:3J< )\_

### Augmented physics:

- [https://youtu.be/tU-a\\_quY7Ko?si=O07qPvJ65fovriLZ](https://youtu.be/tU-a_quY7Ko?si=O07qPvJ65fovriLZ)
- [https://youtu.be/CC3aR6JCFKQ?si=RPX59E\\_2FnTPNj4w](https://youtu.be/CC3aR6JCFKQ?si=RPX59E_2FnTPNj4w)
- [https://youtu.be/c7JbyonM\\_Sg?si=n8T6vNK3gllxRf5y](https://youtu.be/c7JbyonM_Sg?si=n8T6vNK3gllxRf5y)
- [https://youtu.be/95JyoxG8EWE?si=178r4eVMwjLjiz\\_O](https://youtu.be/95JyoxG8EWE?si=178r4eVMwjLjiz_O)

Aug physics are a way to add bounce to the body and head movements.

### Toggles:

- outfit toggle > <https://youtu.be/ZGofky5TYbY?si=INswUZqJZhZ0jmJD>
- idle and toggle animations > <https://youtu.be/eaSskASyTW4?si=bi7WT5MCeF1BZw7V>
- expression toggles > <https://youtu.be/xPJAnzFAuhU?si=NrW9w3HcfZtw0B2>
- magical girl transition > [https://youtu.be/RIX2LoBLcn0?si=UykCoLXk002LoIY\\_](https://youtu.be/RIX2LoBLcn0?si=UykCoLXk002LoIY_)
- color wheel toggle > <https://youtu.be/iSe51OEegZY?si=brMymoP-o0t6iAy>
- chibi toggle > [https://youtu.be/VvP\\_4nYBy4I?si=kBmLUYD-PmhCn-xL](https://youtu.be/VvP_4nYBy4I?si=kBmLUYD-PmhCn-xL)
- fish eye toggle > <https://youtu.be/uqGftLm3LVo?si=L4uANVdOagawfDjL>
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### Physics linking:

- [https://youtu.be/InNGi\\_EZ9hU?si=5vXyhOx\\_n2bZII\\_R](https://youtu.be/InNGi_EZ9hU?si=5vXyhOx_n2bZII_R)
- <https://youtu.be/Ed-fDYY5iP4?si=pLBAbDwlTffBd4uQ>

Toggle physics linking is definitely more **advanced** so I would recommend learning it after understanding physics and augmented physics well..

If you want to learn about physics linking, you will HAVE to watch both videos, because the first one is very hard to follow. I love Kuroama's work but he is terrible as a teacher.

So I probably have to do more figuring out, but from my understanding, what toggle physics linking is: Let's say you have a **hat toggle**, and you want the **head Y physics** to be activated when you turn on the toggle. What you would need to do is put the **hat toggle parameter** as an **input** in the **head Y physics group**.

Now, in the video he said "the problem is it's position based, it means our toggle will be consistently offset" I don't understand any of that. But apparently there is a problem, so the way he fixes it is by putting his **toggle parameters** into **another physics group** (still as **input**), either "**head toggles**" or "**body toggles**" depending on what physics you want to interact with the toggle.

With the example of the hat toggle, he would be putting the **hat toggle parameter** in the "**head toggles**" group as **input**. The **output** would be a blank parameter (has 0 keyframes) called "**head interact**". "**Head interact**" will then be put as an **input** in the **head Y physics group**.

Now here's another thing to think about, this is what he said in comments:

"Here's an example setup. Just make sure the order is correct, else you will have red in the physics group settings. (A physics output can only be used as an input if it's below it in the group setting order).

1. Physics group: Head Toggles  
Inputs: toggles like jacket, hat etc  
Output: A blank param (e.g Head Interact)
2. Physics group: Head Y  
Input: Head Y tracking, Head Interact (angle)  
Output: Head Y
3. Physics group: Hair Y Physics

input: Head Y  
output: Hair Y physics"

### How to rig specific things:

#### Animal ears:

- Cat Athenya > [https://youtu.be/FnhiGuoPos0?si=BvpdH\\_dI5sTgjQaW](https://youtu.be/FnhiGuoPos0?si=BvpdH_dI5sTgjQaW)
- Merely.wufei > <https://youtu.be/DElwBu3k-nA?si=5D6aEIMpiKi2Upyl>
- Cutie Dragon > <https://youtu.be/cQ2SZ3eXvnw?si=WX3osxpRMVw0LrXN>
- Vyris2D > <https://youtu.be/3VszXHMzzYI?si=kcrBaLYEopRjlXj9>

#### Skirt:

- Cat Athenya > <https://youtu.be/8p-SAAh5R7c?si=SlseLil1TMFSb66l>
- Koumori > [https://youtu.be/Flau-Ogp\\_fg?si=ypcbB7zJYoQF7xT3](https://youtu.be/Flau-Ogp_fg?si=ypcbB7zJYoQF7xT3)
- WhimzieCat > [https://youtu.be/122H\\_ew7GgA?si=XoKx3WyApia7PfJY](https://youtu.be/122H_ew7GgA?si=XoKx3WyApia7PfJY)
- cillia > <https://youtu.be/zQKr553cU0k?si=gEokceZo5t8l2354>
- not a skirt but close enough >  
[https://youtu.be/0Q3mEgeSAEo?si=2wla\\_66eWRuxRYL](https://youtu.be/0Q3mEgeSAEo?si=2wla_66eWRuxRYL)
- <https://youtu.be/Gzas9Cseul8?si=WYW8-aNL3olew-CI>
- <https://youtu.be/-2NpMoVFOdE?si=G86lhvN9pY808cjG> (showcase)

#### Water in glass:

- Shiromi > [https://youtu.be/1Mr\\_C817I0A?si=O5WH8F0x\\_cYfJ-Or](https://youtu.be/1Mr_C817I0A?si=O5WH8F0x_cYfJ-Or)
- MOCHIPU > <https://youtu.be/sBcsUfMExhw?si=PI142JJX5OWJtk4R>

#### Fire:

- Leoric Silverbloom > <https://youtu.be/co3sNmYV33M?si=xbl8FBnGyz6mbDpj>
- frame animation > <https://youtu.be/nMhvWDp65xo?si=kjyxsdzGAsRrbmzu>
- Lola Vanpaia > <https://youtu.be/7kXnz3Jad6Q?si=2sjX7p1NtYFTHUBK>

#### Tail:

- 3D effect > <https://youtu.be/YJah3mPLwHM?si=4W5lk4oIBZyYjVC7>
- Dynamic(moves by itself + react to body angles) >  
<https://youtu.be/i2yR9RaH4LM?si=hmk47BS1SN8U6xpH>

#### Boobas:

- Kira Omori at 2:30 > [https://youtu.be/kTbhZQ7AVwg?si=dGkpe8vF\\_4uG4Ro4](https://youtu.be/kTbhZQ7AVwg?si=dGkpe8vF_4uG4Ro4)
- Cutie Dragon > <https://youtu.be/2bG92QzwBd4?si=iFtefDwF5xK9pWZS>
- male boobas > [https://youtu.be/iQ943E4PQbU?si=0xaKMCzk\\_O5oYxY1](https://youtu.be/iQ943E4PQbU?si=0xaKMCzk_O5oYxY1)

#### Accessory:

- gem > [https://youtu.be/JJdNHQNT--0?si=jYb5UB\\_o6f2tj90J](https://youtu.be/JJdNHQNT--0?si=jYb5UB_o6f2tj90J)
- necklace > <https://youtu.be/QHJpYPZl6f8?si=KB1F73e42hZm6W3g>
- earring physics (showcase) >  
[https://youtu.be/0wL\\_FH8-NNg?si=QOrO9a7h8bBB5-cb](https://youtu.be/0wL_FH8-NNg?si=QOrO9a7h8bBB5-cb)

**Wings** > <https://youtu.be/aghCle7dfTI?si=BnyTNH4wUo3rGZKh>

**Glitter** > [https://youtu.be/aMo8e3EQtaM?si=rdHWBFex\\_iSbXEMx](https://youtu.be/aMo8e3EQtaM?si=rdHWBFex_iSbXEMx)

#### Other:

- Double clipping issue > <https://youtu.be/j9MSjYl9UxI?si=geE6Q1m4dIYkRnwl>
- Double clipping issue (both videos give the same solution) > <https://youtu.be/xPhKOP-zSRs?si=KLvZspoQMJfxcdQ3>
- delay to body movement > [https://youtu.be/7CUO9\\_Db5eY?si=ldh-jxanUXK-HTrW](https://youtu.be/7CUO9_Db5eY?si=ldh-jxanUXK-HTrW)
- arm physics > <https://youtu.be/BTYjaX8qRlw?si=tk5sZXd5bSca7Dko>
- how to make a showcase > [https://youtu.be/259iuJ9eN6I?si=cm\\_sUGAUptrWCBB](https://youtu.be/259iuJ9eN6I?si=cm_sUGAUptrWCBB)
- Vbridger > <https://youtu.be/mFUG4L4Lgfo?si=LXTY6MfvEr2Pd61B>
- physics 101 > <https://youtu.be/up861R2u0sk?si=gTb0nTuBAyblJq8d>
- blendshapes > [https://youtu.be/kFPBfTQUhVc?si=3dFS\\_IQMHT6HPbYD](https://youtu.be/kFPBfTQUhVc?si=3dFS_IQMHT6HPbYD)
- template feature > <https://youtu.be/Pk5exgfWFh8?si=woN51fylrq7iQr4w>
- face tracking in live2d > <https://youtu.be/eRcAhp4NWg?si=DRlqWSbRCimFy4Et>
- duplicate the eyes > <https://youtu.be/cqydEx7LJuw?si=wQ00D4oYUoQINFK>
- head shadow edge fix > <https://x.com/dohaonya/status/1951917350548111472?t=FLKxd0HY9DCn0tHlokeHHQ&s=19>
- rotation loop > <https://youtu.be/P23GmTsZHIU?si=tHEuqsiqG4D1KFI>
- cursor tracking > <https://youtu.be/7NyXRIaSLZs?si=-ZiipZazBQgzky6Z>
- hand tracking > <https://youtube.com/shorts/9OFBOf8LNPU?si=prWZ1C-9pMuHSjqo>
- hand tracking guide > <https://www.youtube.com/watch?v=Uea8g4iRR6l&list=PLusfzQQLMeifl2kjmMgnHn26WISYvcVRI>
- Control parameter > <https://youtu.be/0WkTAgm4zm8?si=4YD6G8njoUvJ1FzC>
- Game sprite playlist > <https://www.youtube.com/watch?v=MvglJnAL1Po&list=PLGWPf8yKWbTsI2SPvslwiO-6n4DHsIDhF>
- animate with audio > <https://docs.live2d.com/en/cubism-editor-manual/generating-scene-from-audio-file/>
- live2d cubism 5.2 newest features > <https://youtu.be/ZMdJKx7Qdo0?si=2CjTEEn0h6LdXf37>
- Merely.wufei impressive video! > [https://youtu.be/XfEunZ\\_AY6c?si=wUPlhKd5rEIDtM8R](https://youtu.be/XfEunZ_AY6c?si=wUPlhKd5rEIDtM8R)
- Ox4682B4 360 degree head !?!?!? > <https://youtu.be/uiC51UM6MWE?si=KxTOqbH-ePWRxL7e>
- Chatter model > <https://youtu.be/uinDvhvfSTY?si=Rez9xMsO5G42Kr9r> (I think it's super interesting, I really want to try making one, one day! There are no tutorials for that though so I will have to figure it out by myself with this one video...)

#### About Chatter Model: ( bonus sections I guess )

Damn I love that this doc is helping me learn more things since I'm going through the manual and rewatching interesting videos.

I'm trying to figure out how to make a chatter model right now. At the moment, I haven't tried using blendshape weight limit yet so I might lack knowledge, but it was a bit confusing to me how animations can be offset by a blendshape parameter, and

how the transition between ON and OFF is so smooth(more noticeable by looking at the eye going back to position), as if the parameters were being calculated real time instead of being a strict set animation.

Also, the physics settings were open, with all parameters moving, but the pendulum was not moving and the settings were empty. At first I thought that maybe she animated everything in the physics settings with Breath as input, but the model is moving in a way that is only possible with animation.

So I opened Live2d and was looking for something like "play animation" in the physics settings, and found Playlist > Settings of the cmo3-can3 linkage...

I opened the manual to learn more about it and it's for scene blending. I found out that by making scene groups you can play multiple scenes simultaneously while blending them yyyyyy!! (a scene is basically an animation)

Looking at the video, it definitely looks like that setting was used.

I think Suzuta might have animated ON and OFF in the same animation file (CAN3) as 2 different scenes, then put it in one scene group.

So now I think I can manage to figure that out with some trials and errors YEEEE!!

Might have to experiment on that with artfight!!! so excited

#### Keyboard shortcuts:

Here's the list of shortcut keys page from the manual>

<https://docs.live2d.com/en/cubism-editor-manual/shortcut/>

But you can have access to the list in Live2d from File > Keyboard Shortcuts, or by pressing Ctrl+Alt+Shift+K

Shortcuts are one of the best things!! So make sure to know the keybinds to your most used tools! And set new ones as well.

#### Here's a list of my most important ones:

- Save > [ Ctrl+S ]
- Gif Animation (Export the currently displayed scene as a GIF animation) > [ - ]
- Undo > [ Ctrl+Z ]
- Redo > [ Ctrl+Shift+Z ] or [ Ctrl+Y ] (I use the 1st one more since it's closer)
- Hide selected state > [ H ]
- Show/Hide Bounding Box > [ Ctrl+H ]
- Create Warp Deformer > [ Ctrl+Shift+W ]
- Synthesize Corners > [ Ctrl+4 ]
- Reflect Motion > [ ` ]
- Extended interpolation > [ = ]
- Reset to default values > [ Ctrl+1 ]
- Copy Form > [ Ctrl+Shift+C ]
- Paste Form > [ Ctrl+Shift+V ]
- Temporary path deformation > [ Ctrl+Shift+T ]

- Physics Settings (Opens the Physics Settings dialog box) > [ Ctrl+Shift+P ]
- Bake Animation from Physics > [ Ctrl+Alt+P ]
- Move to the beginning of the timeline > [ Home ]
- Previous frame > [ Page Up ]
- Next frame > [ Page Down ]
- Playback > [ Enter ]

#### More tips:

- When moving something(deformer, artmesh..), if you want to move it in a straight line, press [ Shift ]
- When selecting a keyframe, you might click a bit next to it instead, and not actually select it fully. So when you want to copy/paste a frame, it won't work. To make sure to really select it, right click it instead.
- When transforming a deformer with [ Ctrl ], make sure that there are no keyframes attached, or that you erase its keyframes while making sure you're on the same keyframe which you transformed the deformer on. If you transform a deformer while it has keyframes, the other keyframes will be warped.
- For blendshape parameters, you have to make sure to check the "blend shape" box before adding any keyframes, or else you won't be able to change it

#### Model showcases:

- YorozuyaSaikoro > [https://youtu.be/hm4ju4z6RbM?si=1OaXMG\\_P9WAibFEm](https://youtu.be/hm4ju4z6RbM?si=1OaXMG_P9WAibFEm)
- YorozuyaSaikoro > <https://youtu.be/LO5uM0suAvg?si=zW4JUCXtkGTMCbXn>
- こちゅう(chibi model) > <https://youtu.be/azjszNfemj8?si=gGE34wysVUuwPMzZ>
- こちゅう > <https://youtu.be/EsDxvUcxoVY?si=TV8U3eoVY4gNzfzE>
- SetoKazuya > <https://youtu.be/jSDvZucqmco?si=SgzfWTKfTAEV7BOz>
- Sen Maku (ych chibis) > <https://youtu.be/O3NFTIHHzgM?si=RYmz6JGSdvvyiEha>
- ラビットモンスター > <https://youtu.be/clsfZ-sWopw?si=6du7BAwhpm5e3enQ>
- ラビットモンスター > <https://youtu.be/asv0aPNOzk8?si=OzuJlq-d-4wjTjbE>
- Merely.wufei > [https://youtu.be/XfEunZ\\_AY6c?si=Un15hQSDh4TajeSF](https://youtu.be/XfEunZ_AY6c?si=Un15hQSDh4TajeSF)
- Merely.wufei > [https://youtu.be/opZcr-SjlB0?si=ZkW6O\\_z5qkSj8FIX](https://youtu.be/opZcr-SjlB0?si=ZkW6O_z5qkSj8FIX)
- Cat Athenya (ASMR art) > <https://youtu.be/hwigupUJyh8?si=h5dxxhSgHYRCqeXP>
- 46cm > <https://youtu.be/mj7IIVj0cHQ?si=bcBZfdRhcODkCuOD>
- 46cm > [https://youtu.be/GOEEFjWyUB4?si=DgT5H\\_IX19YCM10L](https://youtu.be/GOEEFjWyUB4?si=DgT5H_IX19YCM10L)
- Norah's Pot > <https://youtu.be/3wQJ3ZGiaWo?si=sHnqYJqKx5Hi6q4u>
- のの > [https://youtu.be/y8Qxce\\_\\_mpA?si=sfMSRuB62vV4PJxR](https://youtu.be/y8Qxce__mpA?si=sfMSRuB62vV4PJxR)
- のの > <https://youtu.be/OFELUa4qKcM?si=M0AHvsW9BXFButHc>
- Vil Rib > <https://youtu.be/387-gnSN3-o?si=NZBA4wjSCKgomY6G>
- Star and Bun > <https://youtu.be/Aqnhkmm3aRM?si=yKnsdeZ51IM5TVzT>
- Tamaghostie > [https://youtu.be/\\_1FfeZOoMGA?si=6fMeyTGE4a3z3SUh](https://youtu.be/_1FfeZOoMGA?si=6fMeyTGE4a3z3SUh)
- Ameki > <https://youtu.be/0SFt0KoBNiU?si=X6btqQ0i33ucbECt>
- ウナギどん > [https://youtu.be/S5C6XXwlr\\_0?si=D8hH4veP-FZ5h8KL](https://youtu.be/S5C6XXwlr_0?si=D8hH4veP-FZ5h8KL)
- idho > [https://youtu.be/H\\_2y-h7RgvE?si=jRUQOOgpCu\\_Ezpm6](https://youtu.be/H_2y-h7RgvE?si=jRUQOOgpCu_Ezpm6)

- 柴酒酒 > <https://youtu.be/45lq-fJcg7M?si=GE7SuBHGJXemCqHP>
- 🌸 花琴新 🌸 channel > [https://youtu.be/JPSqVASdf\\_E?si=AYaSFo2xaUXR1J7S](https://youtu.be/JPSqVASdf_E?si=AYaSFo2xaUXR1J7S)
- Marburg > <https://youtu.be/0nq4Ulb8lI4?si=Z4IY5JhNP1BSVGwb>
- ひいた > [https://youtu.be/4GAPZ0\\_ZIM0?si=BYDqwj-0Dj2rflaK](https://youtu.be/4GAPZ0_ZIM0?si=BYDqwj-0Dj2rflaK)
- あひるに > <https://youtu.be/j9hFxEIGtlc?si=jrClqao2mdgW2XGW>
- Faeri Sami > <https://youtu.be/nMUWC9-dKkl?si=VVP9GtgeBcsZ6wHY>
- Roar > <https://youtu.be/aFYNRq3IKT4?si=j7QM72znFNZYGnK2>
- Kvxart > <https://youtu.be/7OvGvAVpgZ0?si=unUDKo7iAiuNEjVS>
- Himikan > <https://youtu.be/YUNNSLIWKfo?si=nUjCtTVV4-zFuesd>
- Meiyu ch. > [https://youtu.be/YEkAT0TA9mE?si=QtD8VWPvt\\_rlvZpp](https://youtu.be/YEkAT0TA9mE?si=QtD8VWPvt_rlvZpp)
- 0x4682B4 > [https://youtu.be/8vwWF9vNbcs?si=ZKnZ\\_v9ZRd05QmVJ](https://youtu.be/8vwWF9vNbcs?si=ZKnZ_v9ZRd05QmVJ)
- 吉川 エリ > <https://youtu.be/cdtiT1EMJpA?si=glwjUOW9IPIC8Hd8>
- Suzuta > <https://youtu.be/uinDvhvfSTY?si=6RdDMC3UhGOQcld3>
- Shibuya > <https://youtu.be/8N54rXfoY2Y?si=NarVfIXzAzorRhV0>
- Kuroama > <https://youtu.be/4mPIWJNaCas?si=Po8LHCLhBkty2CDs>
- Kuroama > <https://youtu.be/oqihOV5iQTE?si=VQi2ZSYTT4CY8Uvn>

## ANIMATION:

### Tutorials:

- Cutie Dragon > [https://youtu.be/Ebg2eJCi3a4?si=sv1-CDgNISx1sn\\_G](https://youtu.be/Ebg2eJCi3a4?si=sv1-CDgNISx1sn_G)
  - tenC > <https://youtu.be/IDexmSmKnUc?si=snjIYNMPjSYEbOfs>
- For animations I like to do a rough animation “sketch” using the physics settings by putting Breath as an input for at least 1 physics group. It is usually a group that gathers all body and head parameters. Eye and hair physics, everything that originally requires physics are set the same as usual.

### Live2d animations:

- 46cm > [https://youtu.be/6DG\\_J1YJvhY?si=Jlw2xeZYKedi6ZR7](https://youtu.be/6DG_J1YJvhY?si=Jlw2xeZYKedi6ZR7)
- 白ロック > <https://youtu.be/DuCQa8ukrLU?si=XMx9IVDSTnyl7G4t>
- Live2D > <https://youtu.be/96sl9azWMcM?si=tid7MVEzhwatK4SP>
- Live2D > [https://youtu.be/b\\_Yit1OgUTQ?si=fzNdNWB3bB1P-8iM](https://youtu.be/b_Yit1OgUTQ?si=fzNdNWB3bB1P-8iM)
- ラビットモンスター > <https://youtu.be/vhV4xozrSBk?si=pWOf8rYgqmhDu4VZ>
- ラビットモンスター > <https://youtu.be/f2QgRloOQek?si=ykP6rrpPqyPxnrEI>
- ラビットモンスター > [https://youtu.be/vQVvWlILhZI?si=jOjMctTV\\_8cP-Z1z](https://youtu.be/vQVvWlILhZI?si=jOjMctTV_8cP-Z1z)
- ラビットモンスター > <https://youtu.be/YwP4kCxoN90?si=GYbg4Ue23rULM77F>
- RuiUncle > <https://youtu.be/tNgFbyvupyw?si=BneZIXSsWdyScJTG>
- RuiUncle > <https://youtu.be/24OU3EBXo9k?si=xRHmpO5daiQUXsYS>
- itowo > <https://youtu.be/LmlBnaVSrEE?si=j8C8UVTd0KP3-Yjt>
- itowo > <https://youtu.be/u0yS-9kXpUU?si=ldUhTLNZfOGR0cTV>
- Hakumei > <https://youtu.be/yCpN3wOQUkg?si=-uhIIUnubiu-Z7qZ>
- 달팽 > <https://youtu.be/cgMgtg6lch4?si=NB8dO5nfpdGaq0b6>

- 달팽 > <https://youtu.be/tup98i-mqAY?si=eCS3-3BV1mMLZMta>
- Radd > [https://youtu.be/U0R\\_Nc2n9Rk?si=jwG446zwtnP2v7-](https://youtu.be/U0R_Nc2n9Rk?si=jwG446zwtnP2v7-)
- 魔法少女 > <https://youtu.be/0AFdpYhQ0z8?si=rZRsP83riBifDI59>
- shin > <https://youtu.be/89SI4GM1wlQ?si=KdcehnVTrqNEhv29>
- 清水ゆず > [https://youtu.be/2JWW66UCLSQ?si=zB072BLtnxE5nQ\\_b](https://youtu.be/2JWW66UCLSQ?si=zB072BLtnxE5nQ_b)
- Kagari Chinoame > [https://youtu.be/lB5K6\\_IQOsk?si=zpC9Ucr79X1Ytg3c](https://youtu.be/lB5K6_IQOsk?si=zpC9Ucr79X1Ytg3c)
- JiouSiao > <https://youtu.be/lSKYxFxif5s?si=WjiwFp7gcXbofUbv>
- eggutarto > [https://youtu.be/\\_wDn7o3wujk?si=RvHw45-sAkFBPPUG](https://youtu.be/_wDn7o3wujk?si=RvHw45-sAkFBPPUG)
- Popskei > <https://youtu.be/OzYJ5BIVJpQ?si=heusAkOdjDvz0t4L>
- slysheepy > <https://youtu.be/G2oaYFY9ONQ?si=ip2Vu2i7c7-roWGU>
- slysheepy > [https://youtu.be/dOvwP5Z8Egg?si=NbMm3D5a7XX\\_Q7g8](https://youtu.be/dOvwP5Z8Egg?si=NbMm3D5a7XX_Q7g8)

## VTUBE STUDIO:

### Tutorials:

- Chupuko > [https://youtu.be/VitWEHSXkBs?si=WXjlkHOpn\\_QQFRU6](https://youtu.be/VitWEHSXkBs?si=WXjlkHOpn_QQFRU6)
- Merely.wufei > [https://youtu.be/vRGM8cPck\\_Y?si=JBG7kJl81xzBzKmq](https://youtu.be/vRGM8cPck_Y?si=JBG7kJl81xzBzKmq)
- Little Mewn > <https://youtu.be/Fo4EYNCqtiE?si=2yJbRGQ8WuuvctRC>
- setting items > [https://youtu.be/nMcy3X4l\\_QY?si=7OtAsMcpJkin9bZL](https://youtu.be/nMcy3X4l_QY?si=7OtAsMcpJkin9bZL)
- Vtube studio 1.32 > <https://youtu.be/qHCZNCmRbqw?si=gQObuhRFuFrnx5qi>
- Spout2 plugin > <https://youtu.be/cd6EYHDqlmw?si=FzAja7ywEI-pnwZY>
- glow > <https://youtu.be/KkU2salvuKQ?si=Uys2SZFy3-FTcCEh>
- customize clothing in vts > <https://youtu.be/usVemMBC-D8?si=1LtKaV8ySVyvfBPO>
- body assets > [https://youtu.be/Egi\\_VYEO7A?si=v1dp\\_ET3mcG-34pd](https://youtu.be/Egi_VYEO7A?si=v1dp_ET3mcG-34pd)
- transparent capture > [https://youtu.be/-qjyGQ4bjhl?si=HVc\\_-3dz7yeukp5s](https://youtu.be/-qjyGQ4bjhl?si=HVc_-3dz7yeukp5s)
- connect with vbridger > <https://youtu.be/vSIImWn7WzKg?si=k9TErB0ewhKMwjZW>
- connect toggle to twitch redeem >
  - ▶ Headpat Redeem for Twitch using VTube Studio
- VFX effects > ▶ Setup VFX in VtubeStudio! | Tutorial & Effects Guide

Finished writing on june 28th 2025

### Writing in progress stuff:

List of things I want to add:

- How to do mouth rigging for advanced lip sync
- More explanation of Vtube studio

- vbridger

more about mouth tracking:

[Mouth Shapes : r/Live2D](#)

▶ How do Live2D mouths work?? Find out now! 『Live2D Guide 4』

[20mins to learn 'A-I-U-E-O' mouth \(Japanese vowels\) | Editor Tutorial | Live2D Manuals & Tutorials](#)

<https://sl.bing.net/06RCuktNZc>

▶ VTS New feature "Advanced Lipsync" first time trying [Stream VoD]

▶ Vtuberstudio/Live2d "advanced lipsync" experimentation and overview

<https://youtu.be/KOZaCOFQrxE?si=ziz88hgyVdXcmNwt>

About body lean:

I've been confused about body lean for a while but I think I finally managed to figure things out a bit. So usually you have body x, y and z. When the tracking happens in vtube studio, the body movement follows the head angles, which means the body does not have its separate tracking. Since body lean is basically the body leaning down, it's pretty intuitive to rig it in the body y parameter like kuroama is doing in this video > [https://youtu.be/Wd81yDve1vI?si=A\\_lxllbHQMvzF1Rv](https://youtu.be/Wd81yDve1vI?si=A_lxllbHQMvzF1Rv)

So whenever you look down, the body will be leaning down. But I've always been confused because when looking at body lean showcases, the character would have its head look straight ahead instead of down(which is what we want of course). So I was wondering what was the trigger for the body lean.

In Vyris2D's video(<https://youtu.be/l-GTExhIRjQ?si=dwYyejM9uLutBVjY>), she rigs the body lean in the body z parameter and mentions in the comments that the body movements are bound to FacePosition in vtube studio.

In Vtube Studio, the default input for head and body angles are FaceAngle X, Y, Z. However FacePosition X, Y, Z are other input options that basically track where your head is in space. For reference it's like the x, y, z axis in math. I DIDN'T KNOW THEY EXISTED. So FacePositionZ is the one that tracks how close your face is to the camera. Whether you rigged body lean onto the body y or z parameter, you just have to put FacePositionZ as the input in vtube studio.

If your body doesn't move after you changed to FacePosition, make sure to lower the numbers by a lot (for example 1 and -1 or lower)

So it's super nice because you can do even more customization for the other body movements as well, especially in my opinion for the normal body Y movement.

In the video, Vyris says that in her opinion, it's better to make a subtle body lean, and then if you want a big lean, make a toggle instead(gotta figure out how to make that

into a toggle now). But since FacePositionZ is the opposite of sensitive, I feel like it could work to not make it a toggle. You would probably have to get very close/far to the camera to get to the end of the movement. And you can modify the sensitivity as you want with the numbers in vtube studio as well.

I would say making a toggle for body lean would be better only if you want to have more movement diversity. Rig body X, Y, Z as usual, and make an additional body lean parameter that can be toggled on and off (maybe by using blendshape limitations?)

This text is super big, I might need to just make direct one without my thought process later