**※BANDというシステム名が英語の題目に入っていたけど，本文にも一切出てこないよ．ここではひとまず外しました．**

**Automatic Generation of Blowing Animation Taking Fingering and Expression Synchronized with Digital Music into Account**

There are known many animation works with the theme of music performance. Representative televised example of these include “Nodame Cantabile”, “K-ON!”, and “Hibike! Euphonium,”all of which aim at commonly generating realistic motion of performers as well as faithfully reproducing the shape and appearance of the instruments though the underlying production method varies from each other. However, the performer's fingering and motions are sometimes not completely synchronized with music, and thus giving a sense of incompatibility. This type of artifact occurs especially in a scene that he/she plays a fast phrase or in a complex rhythm. Also, facial expressions in animation series occasionally look unnatural. In order to eliminate these kinds of discomfort, it is necessary to manually synchronize the movement of the body one by one with the scale, rhythm, and so on. This work is inefficient because tedious work and much effort are required.

In order to address these issues, there are known works to automatically generate animations of performers playing keyboard instruments and stringed instruments from sound sources. However, to the best of the author’s knowledge, there are no previous works targeting at wind instruments. Therefore, in this thesis research, we aimed to automatically generate blowing animation of characters playing wind instruments from sound sources. For the purpose of animator's work assistance, animation was generated in accordance with the actual animation production flow of musical performance. More specifically, the sound source was generated as a MIDI sound source using an electronic musical instrument. Next, we analyzed the generated sound source to obtain music information. Finally, by applying the obtained information to the character's movement, facial expression, and wind instruments, we generated natural blowing animation synchronized with the sound source.

Evaluation on the resultant animation by third parties empirically proved that the proposed method can generate natural animation automatically.

%音楽演奏をテーマにしたアニメーションはたくさんある．

There exists a lot of animation with the theme of music performance.

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%テレビで放映されたアニメーションの例は，『のだめカンタービレ』，『けいおん！』，『響け！ユーフォニアム』である．

An example of animation aired on television are "Nodame Cantabile", "K-ON!", and "Hibike! Euphonium".

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%これらのアニメーションの制作方法は，セル画や3DCGである．そして，いずれも実際の演奏者の動きに近い演奏シーンが生成されている．

Even though the production methods of these series are different, all of them focus on generating realistic movements of actual performers.

%These animation production methods are cell images or 3D CG, and each performance animation is close to actual performer's movement.

%

%楽器の輝きや形状なども忠実に再現されている．

The shine and shape of the instruments are faithfully reproduced.

%

%しかし，楽器を演奏するキャラクタの運指や身体の動きが，音楽に完全に同期されていないことがある．

However, sometimes the performer's fingering and movement　are not completely synchronized with music and gives a sense of incompatibility.

%

%特に速いフレーズや，複雑なリズムを演奏するシーンで，このようなアーティファクトが起きやすい．

This type of artifact occurs especially in a scene that plays a fast phrase or a complex rhythm.

%

%また，表情からも不自然さを感じることがある．

Also, occasionally facial expressions in animation series are unnatural.

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%これらの違和感を解消するためには，身体の動きを1つずつ音階やリズムなどに，手動で合わせる必要がある．

In order to eliminate these discomfort,

it is necessary to manually synchronize the movement of the body one by one with the scale, rhythm, and so on.

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%この方法は効率が悪く，多くの時間と労力が必要となる．

This method is inefficient, so much time and effort are required.\\

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%上記の課題を解決するため，鍵盤楽器や弦楽器を演奏する演奏者のアニメーションを，音源から自動生成する研究が存在する．

In order to solve these issues, there are works to automatically generate animation of performers playing keyboard instruments and stringed instruments from sound sources.

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%しかし，管楽器を対象とした研究は存在しない．

However, as far as we know, there are no works targeting wind instruments.

%

%そこで本研究では，管楽器を演奏するキャラクタの吹奏アニメーションを，音源から自動生成することを目指した．

Therefore, in this work, we aimed to automatically generate blowing animation of characters playing wind instruments from sound sources.

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%アニメータの作業支援を目的とするため，自動生成の流れは実際の演奏アニメーション制作フローに沿わせた．

For the purpose of animator's work assistance, Animation was generated in accordance with the actual animation production flow of musical performance.

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%より具体的には，楽曲は電子楽器を用いて，MIDI音源として生成する．

More specifically, the sound sources is generated as a MIDI sound source using an electronic musical instrument.

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%次に，作成した楽曲を解析することにより，音楽の情報を得る．

Next, we analyze the generated sound source to obtain music information.

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%最後に，得られた情報をキャラクタの身体の動きや表情，そして管楽器に適用することにより，音源に同期した自然な吹奏アニメーションを実現した．

Finally, by applying the obtained information to the character's movement, facial expression,

and wind instruments, we generated natural blowing animation synchronized with the sound source.\\

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%自動生成したアニメーションについて評価を行った結果，提案手法により，自然なアニメーションを自動的に生成できることを確認した．

Evaluation on automatically generated animation revealed that the proposed method can gerenate natural animation automatically.