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The Use of 5G Network Technology to Reform and Innovate the Culture of Opening Ceremony in Chinese Winter Olympics

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Abstract

The application of 5G network technology in the opening ceremony of the Winter Olympic Games has changed the form of cultural display and made form change and innovation a research hotspot. The original cultural display method cannot meet the requirements of change and innovation, and the innovation effect after the change is poor. To this end, this paper proposes a reform and innovation model based on 5G network technology to improve the form of cultural display. First, wireless self-organization and sensors are used to obtain data in the form of cultural display, and data transformation is carried out through 5G network technology, and the form is changed according to the characteristics of cultural data, and irrelevant change content is abandoned. Then, according to the ultra-wide communication technology, the change rate and display effect of the special effect are analyzed, and compared with the actual reception effect, the parameters and indicators of the cultural display form are adjusted. The innovative design results show that under the condition of 5G network transmission, the transformation and innovation mode can improve the realization effect of cultural display, and the improvement rate is greater than the actual design requirements, which can meet the needs of innovative design.

Keywords: 2D Animation, Style Transfer, Algorithm, Ultra-wide Networks, Innovative Design.

1. Introduction

5G network technology is a network technology that realizes human-machine interconnection, which has the advantages of enhancing bandwidth, reducing latency [1], and massive data processing, which can greatly improve the effect of the Chinese display at the opening ceremony of the 2022 Winter Olympic Games [2], but the original display form has the problem of poor innovation and low change rate, which affects the cultural display effect [3]. How to effectively use 5G network technology to improve cultural display forms is the focus of research on cultural display forms [4]. In the opening ceremonies of the previous Winter Olympic Games [5], the form of cultural display has the problem of poor effect and less special effect content, mainly due to the low transmission rate of video and 3D [6], which cannot meet the actual innovation requirements. According to the survey of

cultural displays of previous Winter Olympic Games [7], it is found that the Winter Olympic Games. have a strong demand for video transmission and cultural special effects.

Table 1. Demand for Chinese Display at the Opening Ceremony of the Winter Olympic Games

Year	Cultural Innovation	Cultural Change	Year	Cultural Innovation	Cultural Change
1970	Rise	Normal	1998	Rise	Normal
1974	Rise	Normal	2002	Rise	Normal
1978	Rise	Normal	2006	Rise	Rise
1982	Rise	Normal	2010	Rise	Rise
1986	Rise	Normal	2014	Rise	Rise
1990	Rise	Normal	2018	Rise	Rise
1994	Rise	Rise	2022	Rise	Rise

Data sources: Video observations, web reviews, and other supporting materials[8]

From Table 1, it shows that since 1970, the trend of cultural innovation and cultural change has been increasing day by day, and it is on the rise. Among them, from 2006 to 2022, the intensity of cultural innovation and change has been continuously strengthened, showing a simultaneous upward trend. Therefore, the objective demand for cultural change and cultural innovation is enhanced, and the corresponding research efforts need to be strengthened [8].5G network technology is an enhanced mobile broadband that can achieve ultra-high data transmission, provide customers with diversified scenario requirements, reduce transmission delay rate, and realize functions such as smart city [9], smart home, and environmental reproduction [10]. Therefore, 5G network technology provides basic conditions for cultural display in the opening ceremony, and the communication improvement rate of 5G network technology is shown in Table 2.

Table 2. Improvement of 5G Network Technology

Index	Data	Rate Of Change
Bandwidth	5gb	200%
Delay	1ms	65%
Transmit Data Lift Rate	1Gbps[10]	200%
Connect Users/Square Kilometer	1 Million	342%

From the data in Table 2, it can be seen that the 5G network can improve the innovation of cultural data, and the transmission capacity, transmission capacity, and transmission speed of cultural data have been greatly improved by more than 50% [11]. Therefore, the 5G network can transmit better and is an important supporting technology for cultural innovation and change. 5G network technology has the advantages of fast transmission and quantitative transmission [12], which can realize the rapid transmission of cultural display content and innovative design [13]. At the same time, in-depth excavation is carried out for cultural display, and the cultural display content, effect, and information integrity under 5G network technology are compared [14]. The literature results show the transmission speed of cultural displays, but there is a problem of screen delay in the transmission process [15]. To apply 5G network technology transmission and intelligent algorithms to the innovation of cultural display forms, it is necessary to integrate the transformation and innovation model and complete the optimization of the cultural display form [16]. Under the condition of clarifying the requirements of the opening ceremony of the Winter Olympic Games, the content of cultural display, and the form of cultural display[17]. The advantages of 5G network technology transmission are compared as shown in Table 3.

Table 3. Cultural Display Advantages of 5G Network Technology

Content	4G Network Technology	5G Network Technology
Data transfer rate per unit time	Conversion of transfer modes	Hierarchical, phased data presentation, and data filtering for automatic adjustment of data form
A complete display of the form	1080P display of colors and movements	Display of 4K technologies such as motion, color, and animation, and reduce the delay between motion transitions
The terminal shows the	High-definition color	Reproduction of integrated movements,

reasonableness of the result	presentation, network appearance	fusion between different colors

Table 3 shows that 5G network is significantly superior to 4G network in terms of transmission time and transmission effect, and the improvement indicators are fundamental indicators, and support mainstream formats such as 1080P [18]. Therefore, in terms of communication indicators, 5G network has basic advantages and can provide technical support. As can be seen from the description in Table 3, although the previous 5G network technology transmission method can initially screen the Chinese display data of the opening ceremony and quickly convert the action data [19]. Therefore, this paper uses the cluster analysis method to cluster the transformation and innovation data, realize the display of color, brightness, and attitude in the form of model conversion and filtering, give full play to the advantages of 5G network technology transmission, and adjust the relevant parameters to achieve comprehensive judgment of data.

2. Related Works

2.1 5G Network Technology Transmission of Cultural Display

The change and innovation model can optimize the transmission of cultural display content, color, and action, while the cluster analysis method clusters the data transmitted by 5G network technology and cultural display data [20], increases the amount of data transmitted at a time, and adds association values, security values, and feedback information in different transmission packets. The communication process of 5G network technology is shown in Figure 1.

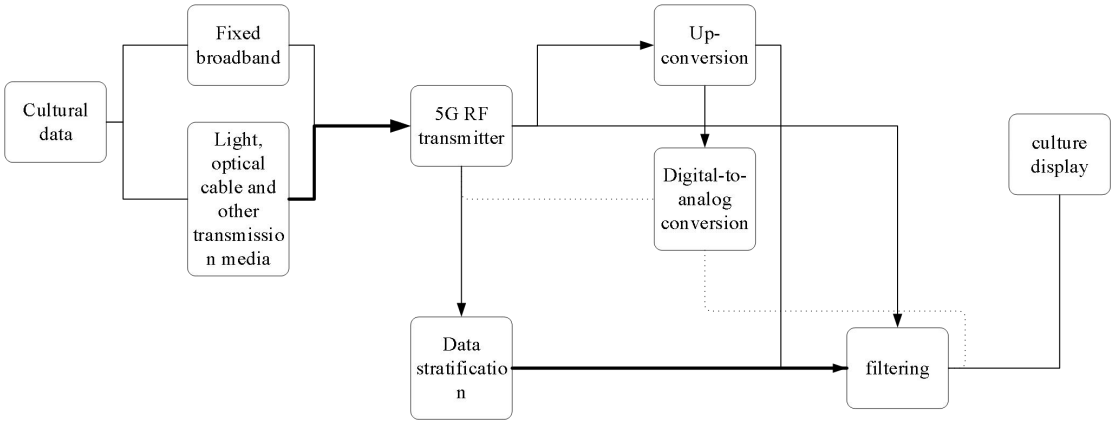

Figure 1. Transmission of Cultural Display Data Under 5G Network Technology

From the data processing process of cultural display in Figure 1, it can be seen that the integration of intelligent algorithms can realize the massive dissemination of cultural display and reduce the loss rate of data tables. 5G network technology can optimize channel matching, transmission stability, and delay for cultural change and innovation data.

Collection of cultural display data: the data of cultural display content is $\sum data_{ij}$, the form change is t_{ij} , the optimization degree of 5G network technology is p [21], the signal mode transmission function is $chaok(d_i \Rightarrow x_j)$, the degree of data clustering is ϕ_i , and the collection of cultural display data is shown in Equation (1):

$$set(k) = chaok(d_i \Rightarrow x_j) \cdot \frac{\sum data_{ij} \cdot t_{ij}}{\phi_i \cdot p} \qquad (1)$$

where, $\sum data_{ij} \cdot t_{ij} < \phi_i \cdot p$ .The content in formula (1) is realized by conditional loop (forr... do) in Java language, so as to call the channel of 5G network and realize the transmission of massive data. The specific results are as follows:

for{Internet 5G;

```
set data =i;
while{data i<tij}
do{download =5G ten;
open = y;
 Trans-modle =3
Accep=data ;
Open (sql);
Other los(sql)}}
```

The transmission and storage of cultural display data can be realized, and modal selection can be made according to the data type to improve the transmission efficiency of data. Form change and innovation: the cultural display innovation function is $f(y_i \Rightarrow x_i)$, the innovation degree evaluation function is $pf(x)$, the change evaluation function is $pF(x)$, the degree of 5G network technology intervention is g, and the realization process of the change and innovation model is shown in Equation (2):

$$f(y_i \Rightarrow x_i) = \frac{pf(x) \cdot pF(x)}{g} \cdot 100\% \tag{2}$$

where, g as the intervention level coefficient of 5G network, the value range should be (0, 1), and it cannot be negative. $y_i \Rightarrow x_i$ is a mapping variable, only its numeric value is taken, excluding non-numeric attributes. Using Java language, the function in formula (2) is calculated in "while …. do" loop, and the result is as follows:

```
While{void chang(data)
{
 Do{ chang-data = x;
  ino = y;
 y= 0;
reas =sum( x+y);
into sql
  } }
```

Cluster analysis method for clustering cultural display data: the innovative clustering amount is Δx_{it}, the clustering function is $jl(\Delta x)$, the fitting function of different clusters is $nh(x)$, and the data processing process of cultural display is shown in Equation (3):

$$swar(y_{ij}, f(x)) = \frac{\lim[A^2 \cdot jl(\Delta x) \cdot y_{ij}]}{nh(x)} \tag{3}$$

Where, $A^2 < 100$ is the adjustment coefficient $jl(\Delta x)$, $nh(x) < \Delta x$.

3. Methodology

3.1 5G Processing of Cultural Display Signals

The cultural display data, cultural display form and cultural display are converted to signal of the innovative form, determine the cultural display frequency value, and the correlation between the frequency value and 5G network technology. In addition, network congestion and delay have an impact on the effectiveness analysis results of cultural display, so it is necessary to analyze the correlation of formal change and realize the signal processing process of innovative forms, and the specific acquisition is shown in Figure 2.

Figure 2.Interface for Acquiring Technical Data of Cultural Display

From the data acquisition interface in Figure 2 that in the process of cultural display analysis, it is necessary to extract signals from innovative forms and determine the transmission signals and characteristic signals, so as to use the transmission range of the 5G network The processing data is classified is shown in Table 4.

Table 4. Signal Processing for Cultural Displays

Test the content / The Type of Data	**Random Sample**	**Animated Rendering**	**Color Rendering**	**Channel Occupancy**	**Innovative Presentation**	**Rendering Integrity**
Structure Class Data	4	466.97	627.21	442.99	40.89	66.97
	2	358.55	563.09	273.42	59.13	58.55
	23	302.38	189.93	30.25	43.44	32.38
	32	166.91	12.19	34.28	92.05	66.91
	13	298.37	261.34	35.53	28.70	98.37
Unstructured Data	2	135.86	457.44	245.37	32.25	35.86
	4	310.62	34.82	342.81	44.05	31.62
	56	33.28	451.93	234.75	57.32	33.28
	2	351.31	599.89	297.17	52.22	35.31
	12	229.32	344.60	440.17	83.06	29.32
Semi-Structured	11	147.39	506.87	20.03	60.20	47.39

Data	32	93.56	280.71	504.67	44.12	93.56
	23	466.97	627.21	442.99	40.89	66.97
	23	358.55	563.09	273.42	59.13	58.55
Normality of the Data		0.75~0.82				
Reasonableness of the Data		0.65~0.82				

From the analysis of the two-dimensional form change points in Table 4, it can be seen that the animation presentation, color presentation, channel occupancy, innovative presentation, integrity, and the integrity of the signal data are good, the cultural display data. The matrix analysis of the data in Table 4 is performed and the matrix eigenvalues are shown in Table 5.

Table 5. Matrix Results of Cultural Presentations

Test / **Test time for cultural presentations**	**Animated rendering**	**Color rendering**	**Channel occupancy**	**Innovative presentation**	**Rendering integrity**
0:00:00	466.97	627.21	442.99	402.89	218060.98
10:35:02	358.55	563.09	273.42	594.13	128558.10
12:07:12	302.38	189.93	30.25	436.44	91433.66
12:53:17	166.91	12.19	34.28	92.05	27858.95
6:12:58	298.37	261.34	35.53	28.70	89024.66
23:06:43	135.86	457.44	245.37	326.25	18457.94
20:00:58	310.62	34.82	342.81	446.05	96484.78
12:28:48	33.28	451.93	234.75	571.32	1107.56
7:32:10	466.97	627.21	442.99	402.89	218060.98
8:08:10	358.55	563.09	273.42	594.13	128558.10
21:53:17	302.38	189.93	30.25	436.44	91433.66
20:15:22	166.91	12.19	34.28	92.05	27858.95
3:11:31	298.37	261.34	35.53	28.70	89024.66
8:42:43	135.86	457.44	245.37	326.25	18457.94
Matrix eigenvalues	0.00	0.00	0.00	0.00	0.00
Demonstrate competence	60.75~70.92%				
Display effects	80.82~90.91%				
Delay	<0.023s				

According to the data in Table 5, the matrix feature values for animation rendering, color rendering, channel occupancy, innovative rendering, and integrity of the data received by 5G network technology are all 0, indicating that there is no abnormal data in the matrix. It also indirectly shows that the data values received under the technical conditions and the form change classification are good, indicating that the cultural display data of the entire 5G network technology is also a small difference, and the delay is less than 0.023 seconds, and the security and stability of the entire 5G network technology state are high.the data display capacity is 80.82~90.91%, which further indicates that the 5G network technology receives data in line with the transmission requirements. However, the display capacity is 60.75~70.92%, indicating that there are great problems in cultural display data and display forms, and the potential for tapping is large, which requires further analysis.

3.2 Analysis of Change and Innovation Based on 5G Network Technology

The change and innovation models, namely form change optimization, cultural display content optimization, and cultural display structure optimization are as follows.

The formal change processing of data optimization in the change and innovation model is shown in Equation (4):

$$inot(x) \approx \int_{i=1}^{n} chan \sum \overline{x}_{ij} \left| content + \sum chanx_{ij} \right| moe \qquad (4)$$

From Equation (4), the 5G processing results of the change and innovation model can be obtained as shown in Table 6.

Table 6. 5G Processing Results of the Transformation and Innovation Model

Receiving Point Distance	Innovative Reception (M)	Change Reception (M)	4G and 5G Switching Frequency (%)
378.83m	174.19	18699.57	6.75
162.92m	71.13	7002.83	3.68
613.48m	198.41	20241.04	2.27
393.24m	279.56	26729.97	3.49
410.99m	229.42	28659.95	9.29
346.6m	239.99	43837.52	9.37
450.59m	416.12	26060.43	1.43
577.18m	338.03	11146.80	5.58
473.49m	224.76	63743.27	2.47
616.15m	292.98	42365.77	5.83
272.43m	512.39	10031.48	0.16
537.97m	174.19	18699.57	6.75
115.97m	71.13	7002.83	3.68

The high reception of the form of change and innovation in Table 6, and the high amount of innovation reception and change reception, indicate that the data transmission effect is better under the technical conditions of the entire 5G network. The switching frequency of 4G and 5G is less than 10%, indicating that the transmission of cultural display data is stable, and the data transmission basis of the opening ceremony of the Games is effectively guaranteed.

4. Results and Discussion

4.1 5G Network Technical Environment for Data Transmission

Based on 5G network technology, combined with cultural display requirements, this paper sets the peak speed to 10~20Gbit/s to realize the display of high-definition video and large-scale virtual reality, and the spectral efficiency is three times that of LTE, which can meet the transmission of CAD and 3D animation. 16 transmitters, 3 8 receiving signal points, 3 servers, 8 clients, LED screen, laser projection joint display, the supplier is Ericsson, Nokia, Samsung are shown in Table 7.

Table 7. Hardware Conditions of 5G Network Technology

Parameter	Hardware Condition	Vendor	Remark
Peak Threshold	22.36 Gbit/s	Ericsson、Nokia	Million Connections per Square Common
Spectrum	> 3x LTE	Ericsson、Nokia	
Number of Frames	72 fps	Ericsson、Nokia	
Color	256 True Colors	Samsung	
Resolution	128*128	Samsung	

Table 7 shows the 5G network technology transmission environment, as shown in Figure 3.

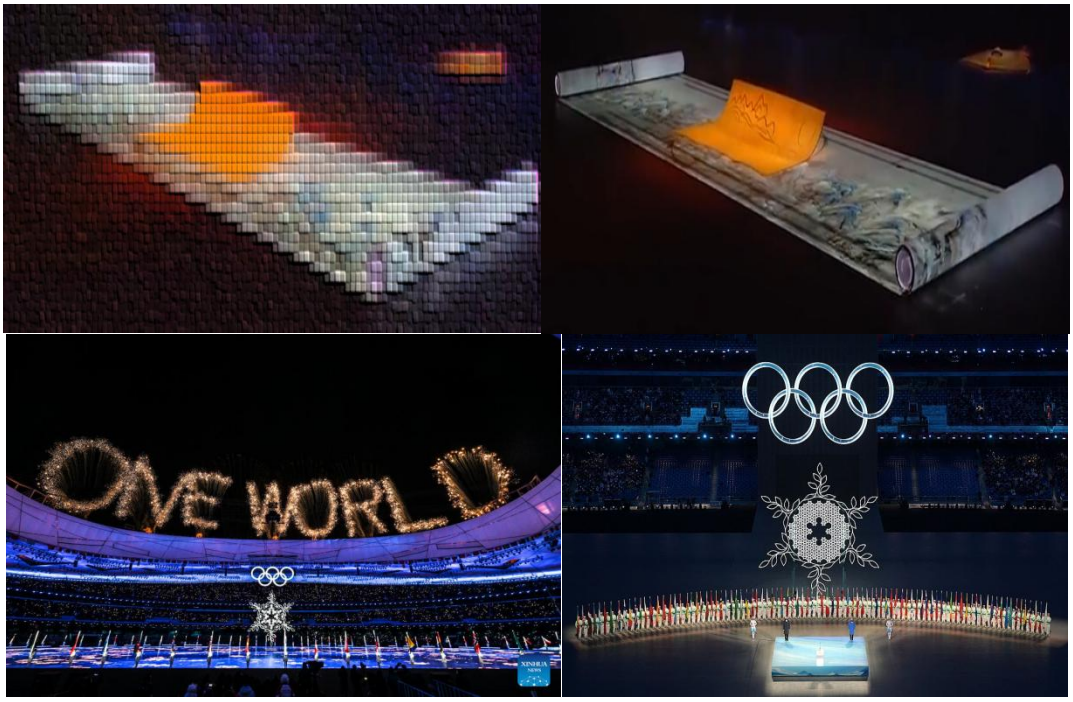

Figure 3. The Effects of Innovation and Change in Cultural Forms

Figure 3 shows the basic and actual display effects of cultural display, and the basic data, as the framework of cultural display, mainly displays the content of formal innovation, and the display effect of formal innovation should be felt by the channel and transmission form. The comparison results in Figure 3 show that the use of 5G network technology can improve the communication effect of cultural forms, present the innovative structure and content, and more accurately restore the original scene. The 5G network technology network can realize a cross-regional innovation effect display, indicating that the innovation effect of 5G network technology is shown in Table 8.

Table 8. Overview of Change and Innovation in Cultural Presentation

Cultural Display Content	Research Directions	Form of Transmission	Innovation And Change Requirements
Content	Content Revolution	5G, 4G Network Technology	75.50
	Content Innovation	5G, 4G, 3G Network Technology	77.01
Constitute	Structural Change	5G, 4G Network Technology	77.65
	Composition Change	5G, 4G Network Technology	76.80
	Organizational Innovation	5G, 4G, 2G Network Technology	76.41
Color	Color Revolution	5G, 4G Network Technology	77.82
	Color Innovation	5G, 4G Network Technology	75.05
Form	Projection	5G, 4G, 2G	76.41

		Network Technology	

4.2 Innovative Rules for Cultural Display

The innovation rules are innovative measures for cultural displays, which can deeply analyze the innovative effects of cultural displays are shown in Table 9.

Table 9. Detailed Rules for Innovation in Cultural Displays

Analysis Method	Innovation Phase	Index	The Degree Of Innovation	Cumulative Amount
Content Innovation	1/6 Upfront	Single Action	67.91	\
		Color	52.89	120.8
		Structure	60.83	181.63
	Mid-Term 1/4	Coherence	26.39	208.02
		Intermittent	43.78	251.8
		Comprehensive	27.84	279.64
	Late 1/2	Visual Innovation	18.16	297.8
		Feel Innovative	64.38	362.18
		Behavioral Innovation	19.47	381.65
		Idea Innovation	40.53	422.18
		Connotation Innovation	39.12	461.3
Form Innovation	3/6 Upfront	Implied Meaning	61.27	522.57
		Compound Action	41.91	564.48
		Feature Segments	80.71	645.19
	Mid-Term 2/4	Impressions	58.98	704.17
		Recall	29.93	734.1
		Memory	8.43	742.53
	Overall	Action	50.35	792.88
		Content	35.07	827.95
		Structure	79.76	907.71
		Coherent	83.70	991.41
		Discontinuity	11.80	1003.21

The innovation rate in Table 9 shows that the innovation is close to 10 times, indicating that 5G network technology reaches more than 10 times. The changing process of cultural demonstration innovation is shown in Figure 4.

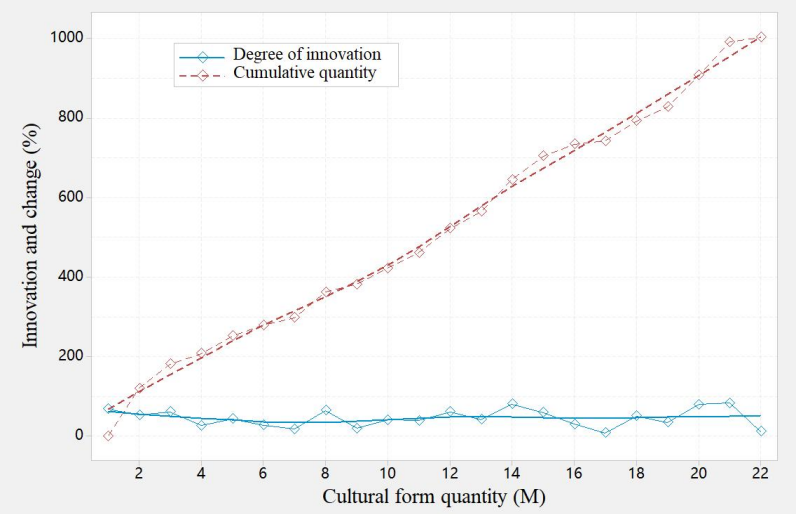

Figure 4. The Process of Judging the Optimization Rate of Cultural Display

From Figure 4, the degree of innovation for cultural display, and the data innovation degree can reach more than 65% in the cultural display.cluster analysis methods, the simplification of the transmission volume of the opening ceremony Chinese display, the improvement of data transmission rate by 5G network technology.

4.3 Change in the Form of Cultural Display

Changes in cultural display will have an impact on color presentation, data transmission, port compatibility, wireless transmission rates, and channel occupancy, so reduce the frequency of changes is shown in Table 10.

Table 10. Impact of Different Cultural Changes on Transmission Indicators

Index	Color Data	New Data Transfer	Port Compatible	Wireless Transmission Rate	Channel Occupancy
Cultural Framework Change	0.15	0.63	5.11	0.35	1.92
	3.37	8.11	3.41	1.01	8.38
Show Details Change	7.83	7.36	4.58	9.52	0.63
	3.53	9.04	5.36	7.15	3.95

The changes in the transmission metrics in Table 10 are shown in Figure 5.

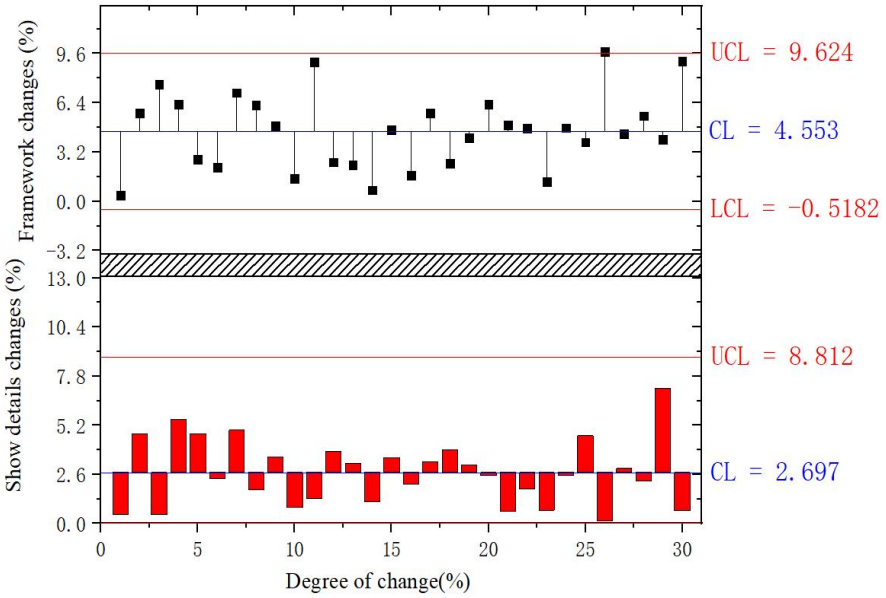

Figure 5. The Degree of Change in Cultural Display

From Figure 5 that under different degrees of change, the framework and content of cultural display have not changed significantly, indicating that the change of cultural display will have less impact on the content displayed. In addition, the framework change is change that has not had any impact on the cultural change, 5G transmission networks can effectively display culture at the opening ceremony of the Winter Olympics. The reason is that 5G technology network through narrow frequency transmission, can reduce the transmission error rate, shorten the delay time, increase the single data transmission volume, since it can fully meet the change requirements of large data volume.

4.4 Transmission stability in the form of cultural display

Stability is the basis of cultural display innovation and change, and it is necessary to conduct multi-frame sampling analysis of feature points are shown in Figure 6.

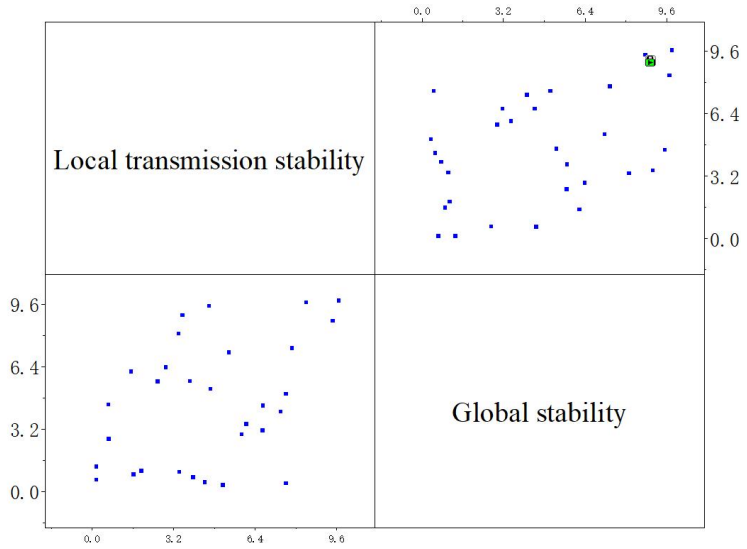

Figure 6. Culture Demonstrates the Stability of Innovation and Change

From Figure 6 that the transmission stability is concentrated in 8.3, and the stability, and concentrated in 9.6. This result shows that the difference between local transport stability and global transmission stability is small, and the final stability of the two is close to 9.6. The above data shows that the 5G technology network can stably transmit the content displayed at the opening ceremony Chinese, meet the actual needs of innovation and change, and achieve effective iteration of data. The data in Figure 6 can be categorized to get the following summary of calculations.

Table 11. Sampling Stability of Cultural Displays

Sampling Method	Parameter	Test Packet Recycling	Receive Stability	Asymptotic Probability
First 1/2 Sampling	Content Innovation	87.67	90.65	0.99
	Color Blending	93.70	94.30	0.94
	Framework Change	93.58	98.92	0.74
Overall Sampling	Content Innovation	92.98	94.61	0.71
	Color Blending	93.70	91.46	0.86
	Framework Change	94.54	96.71	0.94

The first 1/2 sampling and collation sampling results were analyzed, and it was found that in the whole sampling analysis, the test packet recovery rate of content innovation, color fusion and framework change was greater than 80%, the reception stability was 90%, indicating that in different sampling results, The difference between the form of cultural display and the actual presentation result is small, and the stability of reception and recovery rate are greater than 80%, which further shows that 5G network technology can realize the real-time transmission of cultural display data, and change with the sudden change of data and the increase and decrease of data, and can provide wireless communication data support for the innovation and change of cultural display.

4.5 Accuracy of Transmission of Cultural Display Data

The diversity of cultural level effect forms, the presentation of cultural details, and the integration of different colors require a guarantee to accurately judge are shown in Figure 7.

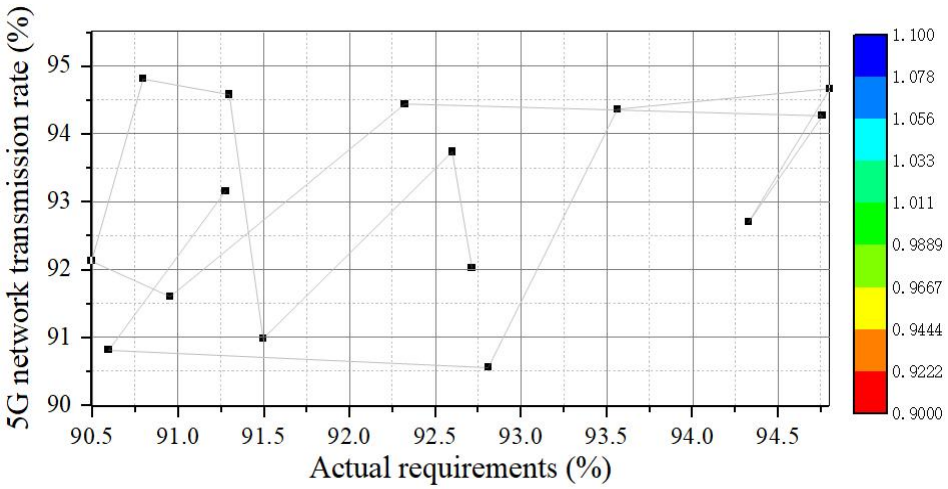

Figure 7. The Transmission Accuracy of Innovation And Change in Cultural Display Forms in the Opening Ceremony

From Figure 7 that the transmission accuracy of cultural display change and innovation is higher than that of 4G network technology transmission, and the transmission results of each cultural display are less different from the actual presentation, indicating that 5G network technology transmission can be accurately completed. The presentation of change and innovation content provides comprehensive support for the Chinese presentation of the opening ceremony, and the results are shown in Table 12.

Table 12. Consistency Rate of Innovation and Change in Cultural Display Forms in the Opening Ceremony

Extract Time	**Theoretical Creation Results**		**5G Network Technology Presents The Results**	
	Form Change	Form Innovation	Form Change	Form Innovation
77.82	92.71	92.03	90.51	91.16
75.05	92.60	93.73	91.13	92.98
76.41	91.50	90.99	92.17	93.75
76.73	91.30	94.57	92.48	91.51
74.52	90.80	94.80	94.43	91.78
75.85	90.50	92.12	93.02	91.81
76.43	90.95	91.61	91.11	90.37
76.94	92.32	94.44	90.45	92.69
76.01	94.76	94.26	92.95	94.33

From the analysis process of Table 12, it can be seen that the consistency rate between theoretical accuracy and actual accuracy is relatively high, and the transmission rate of 5G network technology is slightly higher than the actual requirements, mainly due to the certain delay of 5G network technology, resulting in deviation in the amount of calculated data. However, the agreement rate of the two is basically the same, which further proves that the 5G network technology transmission can meet the requirements. Moreover, in the actual calculation process, the demand is continuously satisfied, and there is no abnormal interference, indicating that the 5G transmission effect of cultural display is ideal, and the reform and innovation of cultural display can be completed.

5. Conclusion

In this paper, a 5G network transmission technology is proposed for the form of Display of the Culture of the Winter Olympics, which can realize the rapid transmission of Display of the Culture of data with a transmission rate of 10Gpits. The test results show that the stability and accuracy of 5G network transmission technology is greater than 90%, and innovative content transmission can be achieved by more than 100 times. In the comparison of the actual test results and the theoretical test results, it is found that the transmission compliance rate of 5G network transmission technology reaches more than 90%, which can meet the actual transmission needs. The reason is mainly the use of 5G network technology to adopt high-frequency transmission, which has high advantages in channel occupation and transmission volume, while the clustering algorithm simplifies and clusters

the change and innovation data, improve the efficiency of data transmission, and meet the innovation and change needs of cultural display.

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