

Digitization of cultural heritage of the UNESCO site - Lipnica Murowana

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ABSTRACT

Lipnica Murowana is a unique, although a small town in the center of the Małopolska Region. It is known of the 15th century St. Leonard wooden church that was entered on the UNESCO World Heritage List in 2003. The article shows the activities of THE MULTISENSORY UNESCO project that was aimed at digitalizing and sharing the cultural and national heritage of Lipnica Murowana. The paper focuses on acoustical layer digitalization. It shows soundscape analysis and recording and the acoustics of the St. Leonard church and other interesting historical monuments.

Keywords: soundscape, ambisonics, wooden church, UNESCO

1. INTRODUCTION

In our life, not only do we seek a sense of security, but also a sense of belonging, which enables us to understand both our own selves and the surrounding reality. This is possible if we reach to the past, which surrounds us everywhere. It manifests itself not only through material objects, but also through stories, memories, everyday life routines, rituals related to some events. Buildings are durable traces of the past, while immaterial resources constitute the binder that fills whole narrative with a content and anchors it in the present.

The sound is not a dominant sense in human perception. Nevertheless, it takes special role in art and human esthetics. It is inseparable element of any landscapes or environment and the acoustic response characterizes any buildings or interiors.

As a part of the THE MULTISENSORY UNESCO project (1), the employees of the Department of Mechanics and Vibroacoustics at AGH UST in Krakow have registered, recorded and analyzed soundscape of Lipnica Murowana together with acoustic measurements in Lipnica's Churches.

2. THE MULTISENSORY UNESCO

Acoustical research and activities shown in current paper were part of complex project THE MULTISENSORY UNESCO (1), that was realized by *Pelni Kultury* foundation (2) in 2017. Within the project, among others St. Leonard's church from the UNESCO site was fully digitalized (Figure 1). In 2003, the wooden churches in southern Małopolska were entered on the UNESCO World Heritage List. The church of St. Leonard in Lipnica Murowana is among these six sites. The justification says that they constitute a unique example of different aspects of the medieval church construction traditions in the Roman-Catholic culture. St. Leonard's church in Lipnica Murowana is one of the historical monuments included in the Wooden Architecture Route in Małopolska which connects over 250 sites. Also, the St. Andrew's church and St. Simon's church located in Lipnica were digitalized as well. St. Andrew's church in Lipnica is over 650 years old and was erected by a decree of King Casimir III the Great in 1363. The contemporary appearance of the church is the result of multiple actions concerning its reconstruction. St. Szymon's church stands on the site of his former family house. It was built in 1636 thanks to the efforts of Stanisław Lubomirski, according to the order of King Władysław IV. The church was rebuilt in the 1960s. The pipe organ inside comes from the 19th century.

The uniqueness of the project goes with sociological, cultural, ethnographical and artistic layers digitalization together with traditional material heritage. Within the project, traditions, oral history, socio-cultural practices such as customs, rituals, annual ceremonies, knowledge and skills related to traditional crafts were digitalized. Therefore, sound and acoustical layer was almost as significant as visual part of the project.



Figure 1 – 3D model of St. Leonard church (3)

The project allows free distribution and sharing of its content in open access philosophy. It is possible to share, transform and use its results to create any new digital content.

Among others, advanced 3D models by laser scanning of all three churches together with their equipment were executed by 3Deling company (3). Additionally, high resolution photos, orthophotos and visualizations of every entry were made.

3. ACUSTICAL LAYER

There were several activities according to the sounds and acoustics within the project:

- acoustical measurements (Figure 2) and analysis of all interiors listed in previous chapter, spatial impulse response measurements using 1st order ambisonic microphone Soundfield ST350, standard omni-directional sound source, commercial full-range active loudspeaker QSC K10 within several locations (Figure 2);
- soundscape of Lipnica Murowana town and surroundings recordings preceded by ethnological surveys and sociological research in order to classify soundscape sound futures and role in local society,
- recordings of unique and local sounds associated with Lipnica Murowana (such as local traditional songs, folklore bands and a positive organ); a positive organ is a portable instrument. It is very similar to a regal. From the outside, it has the form of a wooden coffer or chest, hence its other name: chest or box organ. It contains a keyboard, a system of pipes and two bellows. The instrument in the Lipnica church is dated back to the early 17th century. The positive organ in St. Leonard's Church in Lipnica Murowana is one of seven working instruments of such type in Poland,

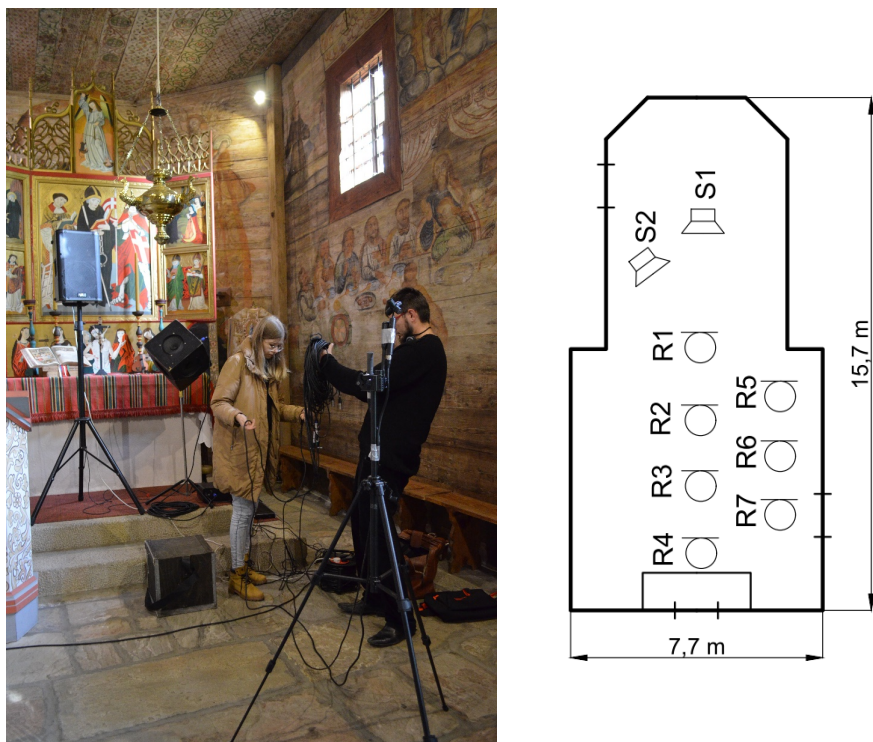


Figure 2 – St. Leonard church interior during the measurements next to its floor plan with microphone and sound source locations

- audio description of the project causes that it is also easily available to people with sight disfunctions.

Measurements results together with the impulse response files are freely available on the project website (1). Results were prepared in numerical and graphical form for: reverberation time (Figure 3), sound clarity for speech and music, spatial and timbre features, speech intelligibility index and other standard room acoustic estimators.

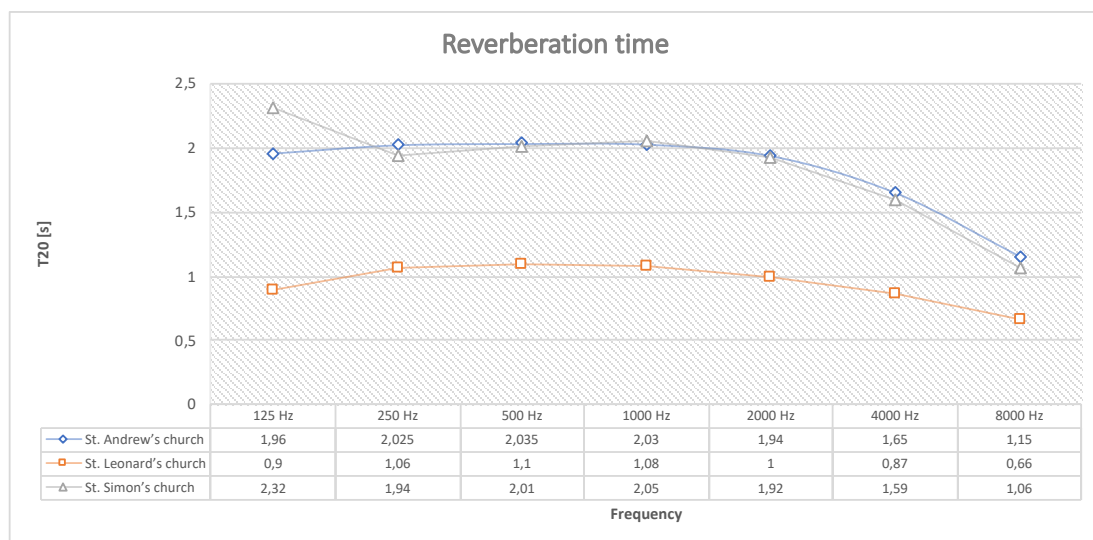


Figure 3 – Reverberation time of measured churches in Lipnica Murowana

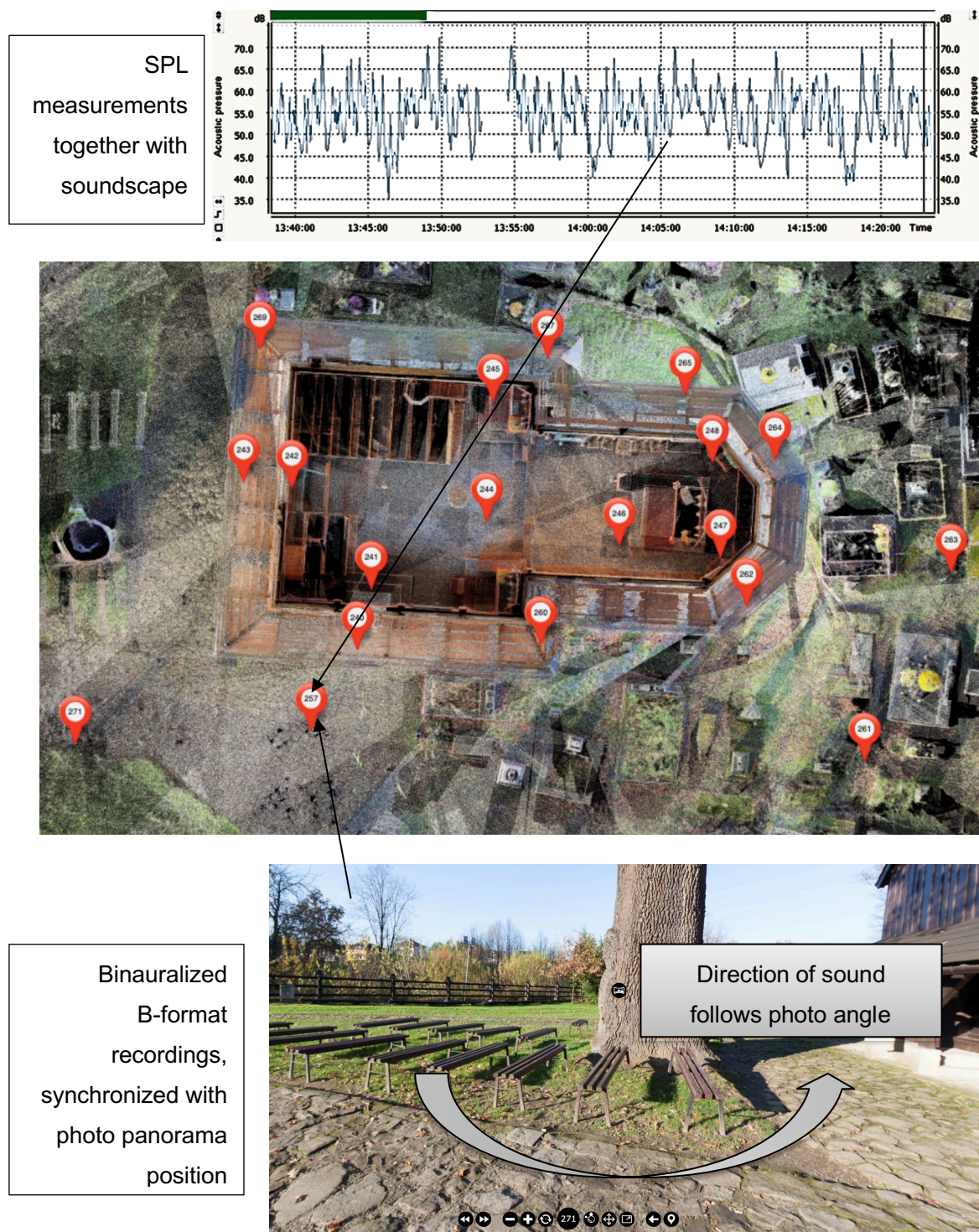


Figure 4 – Reverberation time of measured churches in Lipnica Murowana

On the project website, there is also a set of all impulse responses in several formats and all other recorded sounds free to download. As all recordings were conducted using the ambisonic microphone, there are following formats available:

- B-format,
- stereo,
- binaural,
- 5.1,
- 7.1.

Together with soundscapes recordings, sound pressure level was measured so this data is available

for future use within psychoacoustic test or accurate soundfield playback in laboratory conditions. Some of Lipnica Murowana soundscapes were synchronized with photo panoramas. The concept of connection of ambisonic sounds with photo panoramas is shown in Figure 4. Sounds are decoded from ambisonics to binaural format according to view angle of panorama in real time. In the photo-panoramas inside rooms there is sound of guide or an instrument convoluted with current spatial impulse response.

4. SUMMARY

After the success of Lipnica Murowana digitalization, *Pelni Kultury* foundation continue efforts with another Polish UNESCO sites. The project allows an opportunity to learn about the history of unique places, but—first of all—the people who inhabit it, their stories, traditions and customs. The intensions are to discover this with all senses: to smell the wood of which the oldest buildings here are built, admire the colorful flowers that decorate the famous Easter palms in Lipnica, listen to the conversations of the locals, or touch the oldest historical monuments.

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