4.2 Mobile Learning a new Paradigm of e-Learning in Optics and Photonics [1]

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Introduction

The developed solution enables the presentation of animations and 3D virtual reality (VR) on mobile devices and is well suited for mobile learning, thus creating new possibilities in the area of e-learning worldwide. Difficult relations in physics as well as intricate experiments in optics can be visualised on mobile devices without need for a personal computer (Figure 4.2-1).

Mobile devices are more common than PCs or laptops all over the world but especially in developing nations. They allow internet access also in regions were fixed-line data networks are not widespread. Because engineered for usage in daily live for business and private issues the user interface of mobile devices is more self explaining and easer to handle. Also no lengthy booting procedures and program starting routines must be performed. Typically, mobile devices are switched on all the time. This helps to use mobile devices without being distracted because of necessary high technical knowledge by the user. Hence we recommend to use them for e-learning purpose an approach, called mobile learning. At the same time it increases flexibility combined with a high degree of context awareness. It fits especially to younger people with their high educational needs all over the world. Further, for building up learning arrangements in developing nations one can reach younger people more often via mobile devices than via PC/laptop and fixed-line data network infrastructure.

Recent developments in advanced display technologies and high computational performance on mobile devices open new methods for the visualisation of content like figures, animations and virtual reality [2] – [3]. A critical issue is the adaptation of content both to the individual functionality of a device and its display [4] and to the usability of those devices in learning arrangements.

Fig. 4.2-1: *Mobile phone running 3D VR performed simulation*

Our approach is based on three particular ideas: (i) the shift of computational intensive calculations to the server, (ii) the automated adaptation of the media format and VR description to the mobile, (iii) the definition of learning scenarios best fitted to mobility.

Performed examples of animations

In the context of science, a picture represents an image of a state at a given moment in time. This interpretation may be well suited for time-invariant states, e.g. in the case of the well-known state of matter diagram originating from thermodynamics. A similar success can be achieved when depicting time-invariant states originating from the theory of electricity, e.g. the distribution of streamlines of the field. However, most of the occurring states and processes in nature are dynamic, i.e. they develop over time, so that a momentary still-frame alone is not sufficient to capture their evolution over time. The influence that passive components in an alternating current have on voltage can be visualised well and unambiguously by animating the current or power distributions. For instance, the sense of complex formulas like Fourier-approximations [5] – [6] can be visualised very easily by animations. To solve this task, image sequences have to be generated with the necessary temporal resolution and have to be furthermore well-ordered. The animation is performed by the sequence of 33 frames computed for n = 0 to n = 32. Figure 4.2-2a to 4.2-2h are presenting frames integrated in the Fourier-Animation with a increasing of number n.

Modern techniques allow for an efficient computation of such image sequences and their subsequent viewing: This way scientific animations and Virtual Realities in 3D are created.

FRAMES OF ANIMATED SEQUENCES ON MOBILE DEVICES

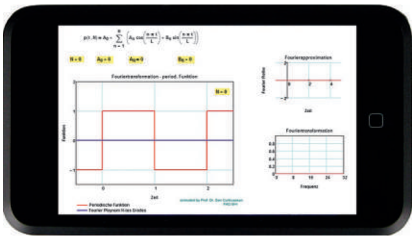

Fig. 2 a: *n = 0*

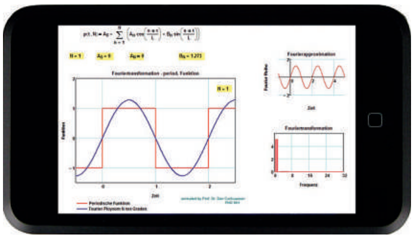

Fig. 2 b: *n = 1*

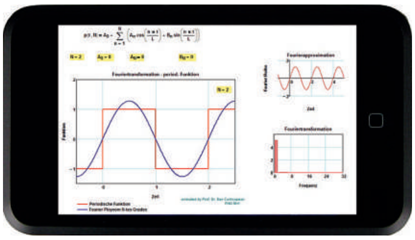

Fig. 2 c: *n = 2*

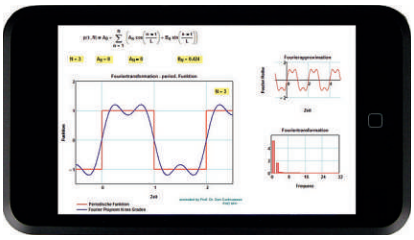

Fig. 2 d: *n = 3*

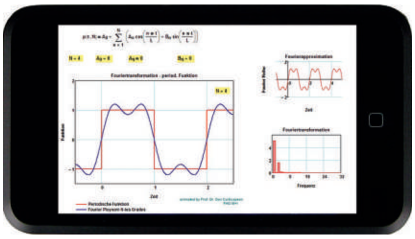

Fig. 2 e: *n = 4*

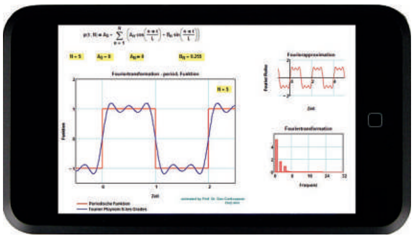

Fig. 2 f: *n = 5*

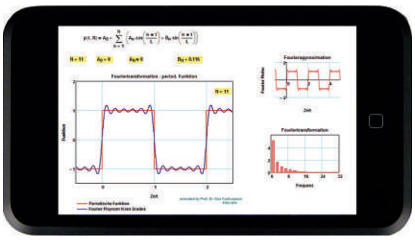

Fig. 2 g: *n = 10*

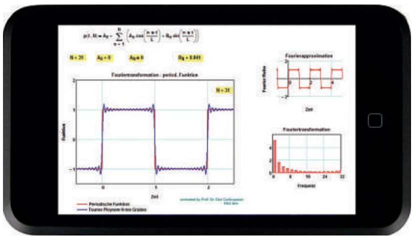

Fig. 2 h: *n = 31*

Fig. 2: *Computed frames integrated in the Fourier-Animation*

References

[1] Der Beitrag wurde von den Autoren Anfang Juli auf der internationalen Biennale „Education and Training in Optics and Photonics“ (ETOP) in der Photonics Academy in St. Asaph (North Wales, UK) vorgestellt. Dabei wurde über den neuesten Stand aus der Forschung auf dem Gebiet der Virtual Reality und m-Learning an unserer Hochschule berichtet.

[2] Feißt M., Curticapean D., Christ A.: „Mobile learning a new paradigm of e-learning in optics and photonics” Education & Training in Optics & Photonics, Photonics Academy St Asaph, North Wales UK, 07.07. 2009

[3] Curticapean D., Feißt M., Christ A.: „3D Mobile Virtual Reality Simulations and Animations using Common Modern Displays” Frontiers in Optics 2008 / Laser Science XXIV / Plasmonics and Metamaterials / Optical Fabrication and Testing (Optical Society of America, Washington, DC, 2008) FThM12, ISBN 978-55752-861-2

[4] Christ A., Feißt M.: „SW-Architecture for Device Independent Mobile Learning” in: Caballe, S.; Xhafa, F.; Daradoumis, T.; Juan, A. A.(editors): „Architectures for Distributed and Complex M-Learning Systems: Applying Intelligent Technologies“. IGI Global, USA, PA. To be published.

[5] Curticapean D.: „Die Macht der Animationen im Unterricht der Naturwissenschaften – eine didaktische Betrachtung“ – Energie der Didaktik – Beiträge zum 7. Tag der Lehre, pag 111 – 114, 2007 ISBN: 978-3-00-022550-5

[6] Allyn J. Washington: “Basic Technical Mathematics with Calculus” 8th Edition, Pearson Addison Wesley – Boston, San Francisco, New York 2005

[7] Jordan D. W., Smith P.: “Mathematical Techniques” 3rd Edition, Oxford University Press 2002