Abstracts of MMA2013 & AMOE2013, May 27–30, 2013, Tartu, Estonia

CONTINUOUS WAVELET TRANSFORM AS A TOOL FOR FRACTAL BROWNIAN MOTION ANALYSIS AND SYNTHESIS

ANDREJS PUCKOVS, ANDREJS MATVEJEVS

Chair of Theory of Probability and Mathematical Statistics, Riga Technical University

Meza iela 1/4, Rīga, LV-1048, Latvija

E-mail: andrejs.puckovs@rtu.lv, andrejs.matvejevs@rtu.lv

This article is dedicated for Fractal Brownian process analysis using Continuous Wavelet Transform (Direct and Inverse). [1] Wavelet Analysis of stochastic processes [2]is very important for financial time series analysis, risk estimation and financial time series forecasting. Wavelet Analysis is very precious for scalability analysis, because of its ability to analyze the signal (process) in scaling and shifting dimensions. [3] In current research, Fractal Brownian motion is analyzed using Direct and Inverse Continuous Wavelet Transform, wavelet coefficients probability density function is estimated, wavelet coefficients lower and upper bounds are calculated using Mexican hat [4] mother wavelet function.

According to research results, Wavelet coefficients of Fractal Brownian process upper interval bound demonstrate more stability at longest time horizons for higher H (Hurst exponent) values. In this case, Wavelet coefficients form a pyramidal shape with a high centre at large scales and large time horizons. For lower H (Hurst exponent values) Wavelet coefficients of Fractal Brownian process upper interval bound are quite small. Wavelet coefficients form convex - concave shape with unexpressed peak in the high-scales and mid-time. Wavelet coefficients for greater Hurst exponent are much divergent from average, while the fractional Brownian process with lower Hurst exponent consistently demonstrates a return to average, so the deviation from average is smaller.

Second main part of this research is Fractal Brownian Motion synthesis, using Continuous Wavelet Transform. Within this research, Fractal Brownian Motion generation algorithms are provided.

REFERENCES

[1] . Continuous wavelet transform. *http://en.wikipedia.org*, [$http://en.wikipedia.org/wiki/Continuous_wavelet_transform$] (Accessed 01 March. 2013.).

[2] . Wavelet Analysis on Stochastic Time Series. *www.rmetrics.org*, [$https://www.rmetrics.org/files/wavelets/wavelets_report.pdf$] (Accessed 01 March. 2013.).

[3] . An Introduction to the Wavelet Transform. *http://intranet.daiict.ac.in/*, [$http://intranet.daiict.ac.in/~ajit_r/IT530/wavelets.pdf$] (Accessed 01 March. 2013.).

[4] . Mexican hat wavelet. *http://en.wikipedia.org/wiki*, [$http://en.wikipedia.org/wiki/Mexican_hat_wavelet$] (Accessed 01 March. 2013.).