D88-PSI.02

NOISE EFFECTS ON THE SECOND-ORDER SAMPLED PULSED DOPPLER ULTRASONIC VELOCIMETER

Gessé Eduardo Calvo Nogueira
IPEN, São Paulo, SP, Brasil, CP 11049, CEP 05422-970 - email - genoguei@net.ipen.br
World Congress on Medical Physics and Biomedical Engineering - NICE'97

The second-order sampling technique doubles the measurable velocity range of pulsed Doppler ultrasonic velocimeters (PDUV). This technique is based on the emission of a delayed sequence of ultrasonic pulses, interlaced to the conventional one. The delay between sequences is adjustable to avoid undesirable sample volumes, originated by the interlaced sequence. The interlaced sequence provides additional samples of blood flow. The extraction of blood velocity parameters from the resulting nonuniform time spaced samples is accomplished by high-order interpolants. The performance of this interpolants depends on the delay between sequences, the intrinsic noise and internal interfering sources in the PDUV. In this work two interpolating methods intended to recover the analog Doppler signal from the nonuniform samples are discussed, focusing noise and interference in the PDUV.

A modified 20 MHz high resolution PDUV is used to achieve first and second-order sampled Doppler signals. Two interpolating filters are digitally implemented: the known second-order interpolator, based on two combined filters, and a recent method, based on the suppression of the aliasing Doppler signal spectrum prior to the interpolation.

The signal-to-noise power ratio resulting from the two interpolating methods, under optimal conditions, are equal for a wide delay range between sequences. The internal interference in the PDUV, however, is strongly attenuated (40 dB) by the filter based on the suppression of the aliasing Doppler signal spectrum, allowing the use of all (doubled) measurable velocity range.

Considering the interference attenuation, signal-to-noise degradation and simplicity of implementation, the interpolating method based on the suppression of the aliasing Doppler signal spectrum presents a superior performance than the known method of combined filters intended to recover second-order sampled signals.

Acknowledgments: This work was supported by PADCT/CNPq

D88-PSI.03

A Flow Model for simulating physiological and pathological vessel systems for Doppler-Ultrasound-Examination

R. Huttary[1,2], M. Verius[1,2], G. Bodner[2], S. M. Giacomuzzi[1,2], O. Ennemoser[2], A. Dessl[1], A. Stöger[1], W. Ambach[2], W. Jaschke[1]
[1] Department of Radiology-Innbruck-Austria (Head. Prof. Dr. W. Jaschke)
[2] Institute of Medical Physics Innsbruck-Austria (Head. Prof. Dr. W. Ambach)

Introduction: To design a physiological and pathological flow model of the vascular system for Doppler-Ultrasound-Examinations.

Materials and Methods: A squeeze pump creates a constant flow of simulated blood (water/glycerin with particles of cellulose) within silicon tubes. The pulsatile flow can be obtained by using a proportional valve which converts the constant flow of the squeeze pump. The operation of the valve can be modified by an electronic device which enables the creation of different signal forms of the pulsatile flow. V*isceral* and *peripheral* signal forms were simulated.

Results: The electronic modification of the pulsative flow enables the creation of a large variety of physiological signal forms. The model also allows the simulation of different patterns of pathologic vessel systems.
A high correlation (R=0.83) was found between the haemodynamics of soft tissue tumors examined in 8 patients and the designed flow model.

Conclusion: The understanding of the haemodynamics of soft tissue tumors and the interpretation of the spectral waves of Doppler-Ultrasound-Signals could be improved by further studies.