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(54) **METHOD FOR ENHANCING OPTICAL SIGNAL-TO-NOISE RATIO MEASURING PRECISION BY CORRECTING SPECTRAL RESOLUTION**

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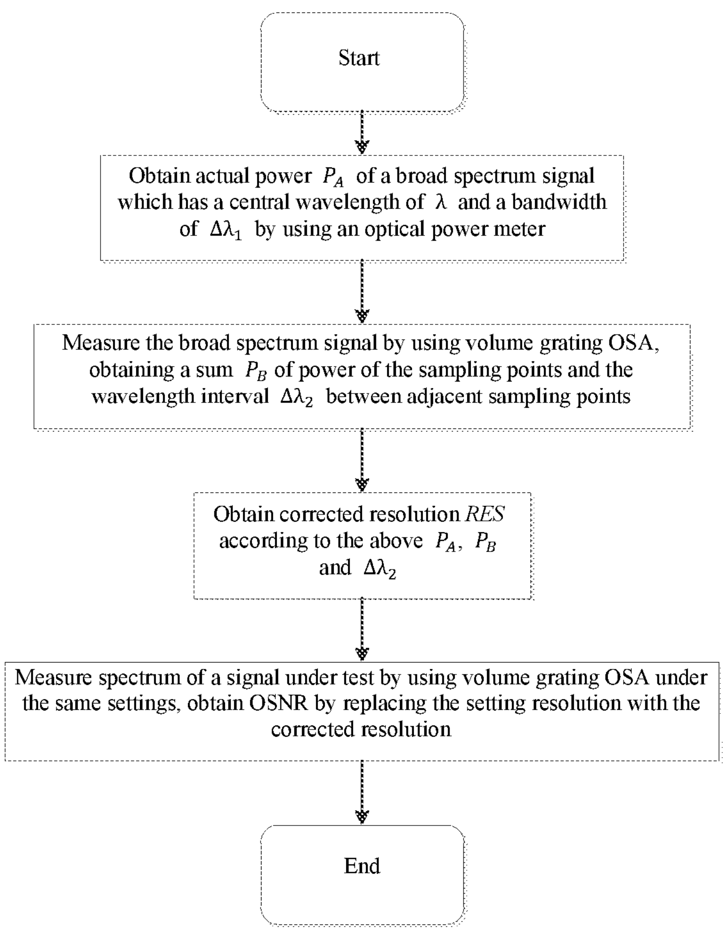
(57) **ABSTRACT**

A method for enhancing optical signal-to-noise ratio measuring precision by correcting spectral resolution is provided, which can obtain optical signal-to-noise ratio with enhanced measuring precision, by measuring actual power of broad spectrum signals in a certain bandwidth, determining the sum of the power of the sampling points for the broad spectrum signals in the bandwidth by using an optical spectrum analyzer, obtaining the corrected resolution of the optical spectrum analyzer, and replacing the setting resolution of the optical spectrum analyzer with the corrected resolution. The method can effectively solve the problem of large OSNR measuring error resulted from the difference between the setting resolution and the actual resolution of optical spectrum analyzer. The method is applicable to correct resolution for all optical spectrum analyzers, and also applicable to enhance the measuring precision for all OSNR measuring methods based on spectrum analysis, and has the advantages of easiness to handle and implement.



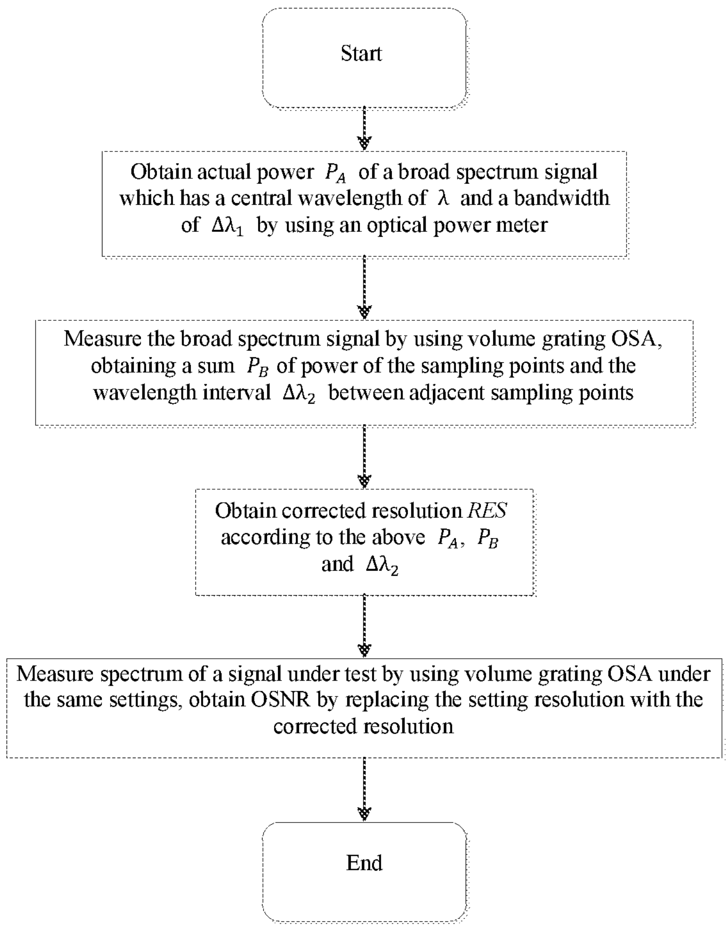

Start
Obtain actual power P_A of a broad spectrum signal which has a central wavelength of λ and a bandwidth of $\Delta\lambda_1$ by using an optical power meter
Measure the broad spectrum signal by using volume grating OSA, obtaining a sum P_B of power of the sampling points and the wavelength interval $\Delta\lambda_2$ between adjacent sampling points
Obtain corrected resolution RES according to the above P_A, P_B and $\Delta\lambda_2$
Measure spectrum of a signal under test by using volume grating OSA under the same settings, obtain OSNR by replacing the setting resolution with the corrected resolution
End

FIG. 1

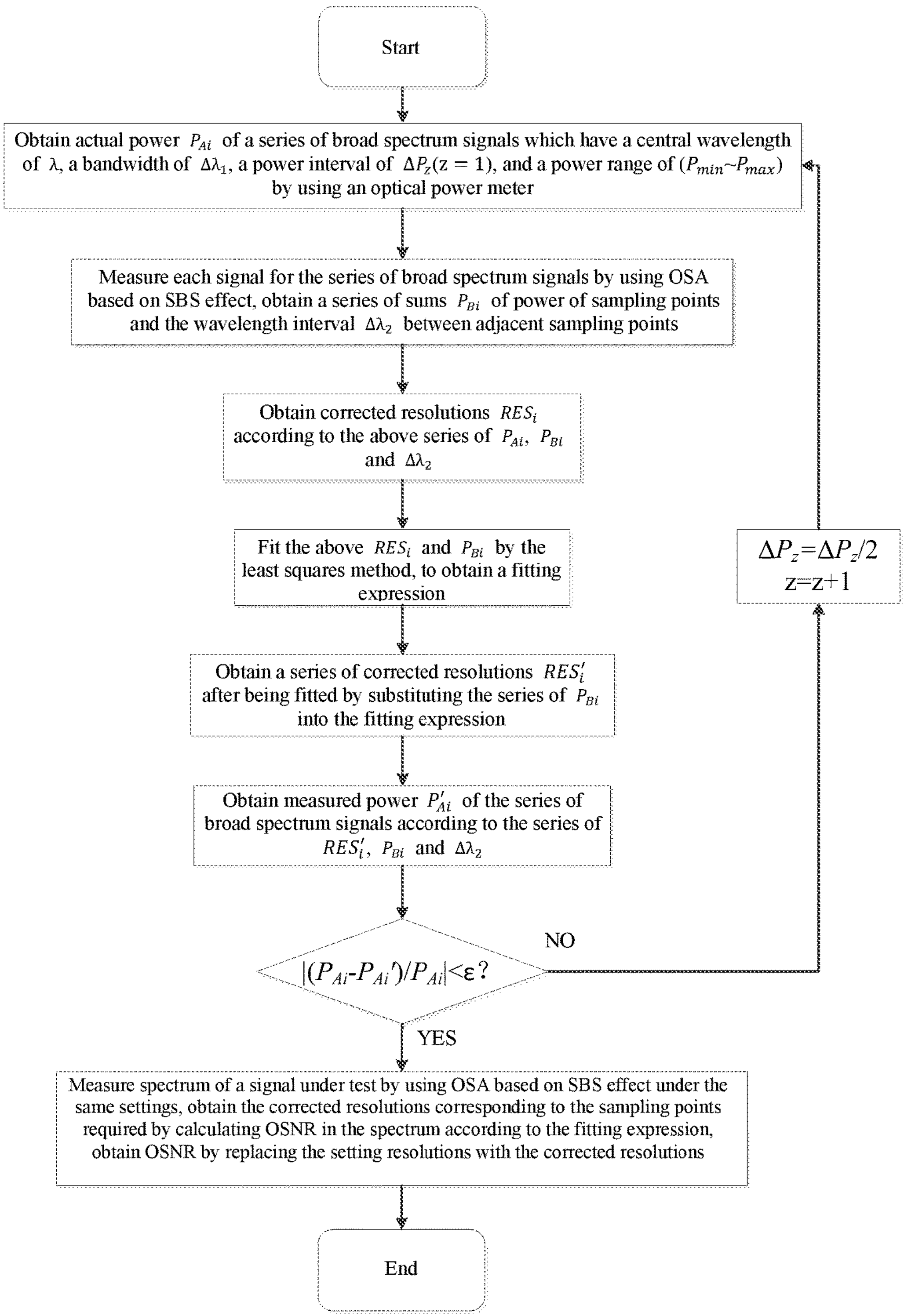

Start
Obtain actual power P_{Ai} of a series of broad spectrum signals which have a central wavelength of λ, a bandwidth of $\Delta\lambda_1$, a power interval of $\Delta P_z(z=1)$, and a power range of $(P_{min}$~$P_{max})$ by using an optical power meter
Measure each signal for the series of broad spectrum signals by using OSA based on SBS effect, obtain a series of sums P_{Bi} of power of sampling points and the wavelength interval $\Delta\lambda_2$ between adjacent sampling points
Obtain corrected resolutions RES_i according to the above series of P_{Ai}, P_{Bi} and $\Delta\lambda_2$
Fit the above RES_i and P_{Bi} by the least squares method, to obtain a fitting expression
Obtain a series of corrected resolutions RES_i' after being fitted by substituting the series of P_{Bi} into the fitting expression
Obtain measured power P_{Ai}' of the series of broad spectrum signals according to the series of RES_i', P_{Bi} and $\Delta\lambda_2$
$|(P_{Ai}-P_{Ai}')/P_{Ai}|<\varepsilon$?
NO
$\Delta P_z=\Delta P_z/2$
z=z+1
YES
Measure spectrum of a signal under test by using OSA based on SBS effect under the same settings, obtain the corrected resolutions corresponding to the sampling points required by calculating OSNR in the spectrum according to the fitting expression, obtain OSNR by replacing the setting resolutions with the corrected resolutions
End

FIG. 2

METHOD FOR ENHANCING OPTICAL SIGNAL-TO-NOISE RATIO MEASURING PRECISION BY CORRECTING SPECTRAL RESOLUTION

TECHNICAL FIELD

[0001] The invention relates to the field of optical performance monitoring technology, and more particularly, to a method for enhancing optical signal-to-noise ratio measuring precision by correcting spectral resolution.

BACKGROUND OF THE INVENTION

[0002] Optical Signal to Noise Ratio (OSNR) is a ratio of signal power in a channel to noise power in a specific bandwidth range. OSNR indicates the level of noise in the signal, and is one of important technical indicators for optical performance monitoring.

[0003] Generally, OSNR is measured by out-of-band monitoring method based on an optical spectrum analyzer (OSA), which is recommended by ITU-T G.697. This method is characterized in that OSNR is calculated by estimating noise in channels with interchannel noise, and is widely used since it is easy and does not affect service.

[0004] This OSNR measuring method based on spectrum analysis has the following disadvantage: due to the factors such as mechanical adjustment in OSA or external environment change and so on, its setting resolution may be different from its actual resolution, which results in low precision for measuring OSNR based on the spectrum method.

SUMMARY OF THE INVENTION

[0005] In view of the above-mentioned problems in the prior art, the present invention provides a method for enhancing optical signal-to-noise ratio measuring precision by correcting spectral resolution, which aims to replace the setting resolution of OSA with corrected resolution, so as to obtain OSNR, thereby solving the problem of large error resulted from the difference between setting resolution and actual resolution when OSNR is measured by using OSA.

[0006] In order to achieve the objective of the invention, a method for enhancing optical signal-to-noise ratio measuring precision by correcting spectral resolution is provided, including the following steps of:

[0007] (1) obtaining actual power P_{Ai} of a series of broad spectrum signals which have a central wavelength of λ, a bandwidth of $\Delta\lambda_1$, a power interval of ΔP_z, and a power range of (P_{min}~P_{max}),

[0008] wherein, i=1, 2, . . . , n; z=1; P_{min} is the minimal power of broad spectrum signals; P_{max} is the maximum power of broad spectrum signals; the power range of (P_{min}~P_{max}) of the broad spectrum signals could cover the dynamic range of power of signals under test;

[0009] (2) measuring a spectrum of each signal for the above series of broad spectrum signals by using OSA, adding up the power of sampling points which fall into the spectrum range having a central wavelength of λ and a bandwidth of $\Delta\lambda_1$, to obtain a sum of power of the sampling points, thereby to obtain a series of sums P_{Bi} for the above series of broad spectrum signals; in which, i=1, 2, . . . , n,

[0010] wherein, a display central wavelength of the OSA is set to be λ, a display wavelength range of the OSA is set to be $\Delta\lambda_1$, a wavelength interval between adjacent sampling points is $\Delta\lambda_2$; the number of sampling points is n; the value of setting resolution is Res_{set}; and n~$Res_{set} \geq \Delta\lambda_1$;

[0011] (3) obtaining corrected resolutions $Res_i = P_{Bi} \cdot \Delta\lambda_2 / P_{Ai}$, according to the actual power P_{Ai} of the series of broad spectrum signals, the sums P_{Bi} of power of the sampling points, and the wavelength interval $\Delta\lambda_2$;

[0012] (4) fitting the corrected resolutions Res_i and the sums P_{Bi} of power of the sampling points by the least squares method, to obtain a fitting expression of ($Res-P_B$);

[0013] (5) substituting the above series of sums P_{Bi} of power of sampling points in the step (2) into the fitting expression of ($Res-P_B$), to obtain a series of corrected resolutions RES'_i after being fitted;

[0014] obtaining measured power of the series of broad spectrum signals $P'_{Ai} = P_{Bi} \cdot \Delta\lambda_2 / RES'_i$, according to the series of corrected resolutions RES'_i after being fitted, the sums P_{Bi} of power of the sampling points, and the wavelength interval $\Delta\lambda_2$;

[0015] (6) according to the actual power P_{Ai} and the measured power P'_{Ai} of broad spectrum signals, calculating relative errors

$$\left|\frac{P_{Ai} - P'_{Ai}}{P_{Ai}}\right|;$$

[0016] and determining whether the following formula

$$\left|\frac{P_{Ai} - P'_{Ai}}{P_{Ai}}\right| < \varepsilon$$

is satisfied,

[0017] if yes, it is indicated that the corrected resolution can replace the actual resolution;

[0018] performing step (7);

[0019] if no, it is indicated that there is a large error between the corrected resolution and the actual resolution; then, making $\Delta P_\Delta = \Delta P_z / 2$, z=z+1, and repeating steps (1)-(5),

[0020] wherein, 0<ε<1;

[0021] (7) measuring a spectrum of a signal under test under the same settings as in the step (2) by using OSA, to obtain corrected resolutions corresponding to sampling points required by calculating OSNR in the spectrum; replacing the setting resolutions with the corrected resolutions to obtain OSNR.

[0022] Preferably, for the above method for enhancing optical signal-to-noise ratio measuring precision by correcting spectral resolution, step (7) includes the following sub-steps of:

[0023] (7.1) measuring the spectrum of the signal under test which has a central wavelength of λ and a bandwidth of $\Delta\lambda_3$, under the same settings as in the step (2) by using OSA;

[0024] substituting $P_{Bj} = P_{aj} \cdot \Delta\lambda_1 / \Delta\lambda_2$ into the fitting expression of ($Res-P_B$), to obtain the corrected resolutions Res_{aj} corresponding to the sampling points required by calculating OSNR in the spectrum,

[0025] wherein, P_{aj} are the power of the sampling points required by calculating OSNR in the spectrum, j=1, 2, . . . , m, and $\Delta\lambda_3 \leq \Delta\lambda_1$;

[0026] (7.2) obtaining a total power of the signal under test

$$P(\Delta\lambda_3)=\sum_{k=1}^{l}\frac{P_{bk}\cdot\Delta\lambda_2}{Res_{bk}},$$

[0027] wherein, P_{bk} are the power of sampling points which fall into the spectrum range having a central wavelength of λ and a bandwidth of $\Delta\lambda_3$, k=1, 2, . . . , l; Res_{bk} are the corrected resolutions corresponding to the power of sampling points P_{bk};

[0028] (7.3) obtaining a total power of noise

$$N(\Delta\lambda_3)=f\left[\sum_{t=1}^{s}\frac{P_{ct}\cdot\Delta\lambda_2}{Res_{ct}},\sum_{p=1}^{q}\frac{P_{dp}\cdot\Delta\lambda_2}{Res_{dp}}\right],$$

[0029] wherein, f is an undetermined function, and its specific expression is determined according to a used OSNR measurement method; P_{ct} and P_{dp} are the power of sampling points in the spectrum range required by calculating noise, t=1, 2, . . . , s, p=1, 2, . . . , q; Res_{ct} and Res_{dp} are corrected resolutions corresponding to the power P_{ct} and P_{dp} of sampling points, respectively;

[0030] (7.4) obtaining optical signal to noise ratio

$$OSNR=10lg\frac{P(\Delta\lambda_3)-N(\Delta\lambda_3)}{N(\Delta\lambda_3)\cdot\lambda_r/\Delta\lambda_3},$$

[0031] wherein, λ_r is a reference bandwidth, and is set to be 0.1 nm.

[0032] In general, comparing to the prior art, the above technical solution in the present invention can achieve the following advantageous effects:

[0033] (1) the method for enhancing optical signal-to-noise ratio measuring precision by correcting spectral resolution provided in the invention can obtain the signal power and the noise power in the signals under test more accurately, so as to enhance the OSNR measuring precision, by measuring actual power of the broad spectrum signals in a certain bandwidth, determining the sums of the power of the sampling points in the certain bandwidth for the broad spectrum signals by using an optical spectrum analyzer, obtaining the corrected resolution of optical spectrum analyzer, and replacing the setting resolution with the corrected resolution;

[0034] (2) the method is applicable to correct resolution for all optical spectrum analyzers, and also applicable to enhance measuring precision for all OSNR measuring methods based on spectrum analysis, and has the advantages of easiness to handle and implement.

BRIEF DESCRIPTION OF ACCOMPANYING DRAWINGS

[0035] FIG. **1** is a flow chart of a process for enhancing the OSNR measuring precision by correcting the resolution of volume grating OSA in embodiment 1 of the invention;

[0036] FIG. **2** is a flow chart of a process for enhancing the OSNR measuring precision by correcting the resolution of OSA based on stimulated Brillouin scattering effect in embodiment 2 of the invention.

SPECIFIC EMBODIMENTS OF THE INVENTION

[0037] For clear understanding of the objectives, features and advantages of the invention, detailed description of the invention will be given below in conjunction with accompanying drawings and specific embodiments. It should be noted that the embodiments are only meant to explain the invention, and not to limit the scope of the invention.

[0038] The method for enhancing optical signal-to-noise ratio measuring precision by correcting spectral resolution provided in the invention aims to enhance OSNR measuring precision by correcting resolution and reducing the difference between the setting resolution and the actual resolution.

[0039] FIG. **1** illustrates a process for enhancing the OSNR measuring precision by correcting the resolution of volume grating OSA in embodiment 1. The resolution of a conventional volume grating OSA is set according to the slit width of monochromator, and is different from its actual resolution. However, the resolution of volume grating OSA is kept consistent when input power is changed.

[0040] Embodiment 1 provides a method for enhancing the OSNR measuring precision by correcting the resolution of volume grating OSA, including the following steps of:

[0041] (1) obtaining actual power P_A of a broad spectrum signal which has a central wavelength of λ and a bandwidth of $\Delta\lambda_1$ by using an optical power meter,

[0042] wherein, P_A makes the power of broad spectrum signal to be in the dynamic range of power of signal under test; the broad spectrum signal is generated from an erbium doped fiber amplifier (EDFA), the central wavelength λ and bandwidth $\Delta\lambda_1$ of the broad spectrum signal can be obtained by adjusting a tunable filter, and its output power can be controlled by adjusting an optical attenuator;

[0043] (2) measuring a spectrum of the above broad spectrum signal by using the volume grating OSA, adding up the power of sampling points which fall into the spectrum range having a central wavelength of λ and a bandwidth of $\Delta\lambda_1$, to obtain a sum P_B of power of the above sampling points,

[0044] wherein, a display central wavelength of the volume grating OSA is set to be λ, a display wavelength range is set to be $\Delta\lambda_1$, a wavelength interval between adjacent sampling points is $\Delta\lambda_2$; the number of sampling points is n; the value of setting resolution is Res_{set}; and $n\cdot Res_{set}\geq\Delta\lambda_1$;

[0045] (3) obtaining a corrected resolution $Res=P_B\cdot\Delta\lambda_2/P_A$, according to the actual power P_A of the broad spectrum signal, the sum P_B of power of the sampling points, and the wavelength interval $\Delta\lambda_2$;

[0046] (4) measuring a spectrum of a signal under test under the same settings as in the step (2) by using the volume grating OSA, replacing a setting resolution with a corrected resolution to obtain OSNR, which specifically includes the following sub-steps of:

[0047] (4.1) measuring the spectrum of the signal under test which has a central wavelength of λ and a bandwidth of $\Delta\lambda_3$, under the same settings as in the step (2) by using the volume grating OSA, wherein $\Delta\lambda_3\leq\Delta\lambda_1$;

[0048] (4.2) obtaining a total power of the signal under test

$$P(\Delta\lambda_3)=\sum_{k=1}^{l}\frac{P_k\cdot\Delta\lambda_2}{Res},$$

[0049] wherein, P_k are the power of sampling points which fall into the spectrum range having a central wavelength of λ and a bandwidth of $\Delta\lambda_3$, k=1, 2, ... , l;

[0050] (4.3) obtaining a total power of noise: in the case that OSNR is measured by an out-of-band monitoring method, the total power of noise

$$N(\Delta\lambda_3)=\left(\frac{P(\lambda-\Delta\lambda)}{Res}+\frac{P(\lambda+\Delta\lambda)}{Res}\right)\cdot\frac{\Delta\lambda_3}{2},$$

[0051] wherein, P(λ−Δλ) and P(λ+Δλ) are the power of sampling points at wavelengths of λ−Δλ and λ+Δλ, respectively, wherein, λ indicates central wavelength;

[0052] (4.4) obtaining optical signal to noise ratio

$$OSNR=10lg\frac{P(\Delta\lambda_3)-N(\Delta\lambda_3)}{N(\Delta\lambda_3)\cdot\lambda_r/\Delta\lambda_3};$$

[0053] wherein, λ_r is a reference bandwidth, and is set to be 0.1 nm in embodiment 1.

[0054] In the present invention, the signal power and the noise power in the signal under test can be obtained more accurately, so as to enhance the OSNR measuring precision, by obtaining a corrected resolution of volume grating OSA, and replacing a setting resolution with a corrected resolution.

[0055] FIG. **2** illustrates a process for enhancing the OSNR measuring precision by correcting the resolution of OSA based on stimulated Brillouin scattering (SBS) effect in embodiment 2. Unlike volume grating OSA, the actual resolution of which is kept consistent, an actual resolution of OSA based on SBS effect will change as input signal power changes.

[0056] Embodiment 2 provides a method for enhancing the OSNR measuring precision by correcting the resolution of OSA based on SBS effect, including the following steps of:

[0057] (1) obtaining actual power P_{Ai} of a series of broad spectrum signals which have a central wavelength of λ, a bandwidth of $\Delta\lambda_1$, a power interval of ΔP_z, and a power range of (P_{min}~P_{max}) by using an optical power meter,

[0058] wherein, i=1, 2, . . . , n; z=1; P_{min} is the minimal power of broad spectrum signals; P_{max} is the maximum power of broad spectrum signals; the power range of (P_{min}~P_{max}) of the broad spectrum signals could cover the dynamic range of power of signals under test; the broad spectrum signals are generated from EDFA, the central wavelength λ and bandwidth $\Delta\lambda_1$ of the broad spectrum signals can be obtained by adjusting a tunable filter; and output power can be controlled by adjusting an optical attenuator;

[0059] (2) measuring a spectrum of each signal for the series of broad spectrum signals by using OSA based on SBS effect, adding up the power of sampling points which fall into the spectrum range having a central wavelength of λ and a bandwidth of $\Delta\lambda_1$, to obtain a sum of power of the sampling points, thereby to obtain a series of sums P_{Bi} for the above series of broad spectrum signals, in which, i=1, 2, . . . , n,

[0060] wherein, a display central wavelength of OSA based on SBS effect is set to be λ, a display wavelength range is set to be $\Delta\lambda_1$, a wavelength interval between adjacent sampling points is $\Delta\lambda_2$; the number of sampling points is n; the value of setting resolution is Res_{set}; and $n\cdot Res_{set}\geq\Delta\lambda_1$;

[0061] (3) obtaining corrected resolutions $Res_i=P_{Bi}\cdot\Delta\lambda_2/P_{Ai}$, according to the actual power P_{Ai} of the series of broad spectrum signals, the sums P_{Bi} of power of the sampling points, and the wavelength interval $\Delta\lambda_2$;

[0062] (4) fitting corrected resolutions Res_i and the sums P_{Bi} of power of the sampling points by the least squares method, to obtain a fitting expression of ($Res-P_B$);

[0063] (5) substituting the above series of sums P_{Bi} of power of sampling points in the step (2) into the fitting expression of ($Res-P_B$), to obtain a series of corrected resolutions RES'_i after being fitted;

[0064] obtaining the measured power of the series of broad spectrum signals $P'_{Ai}=P_{Bi}\cdot\Delta\lambda_Z/RES'_i$, according to the series of corrected resolutions RES'_i after being fitted, the sums P_{Bi} of power of the sampling points, and the wavelength interval $\Delta\lambda_2$;

[0065] (6) according to the actual power P_{Ai} and the measured power P'_{Ai} of broad spectrum signals, calculating relative errors

$$\left|\frac{P_{Ai}-P'_{Ai}}{P_{Ai}}\right|;$$

[0066] and determining whether the following formula

$$\left|\frac{P_{Ai}-P'_{Ai}}{P_{Ai}}\right|<\varepsilon$$

is satisfied,

[0067] if yes, it is indicated that the corrected resolution can replace the actual resolution; performing step (7);

[0068] if no, it is indicated that there is a large error between the corrected resolution and the actual resolution; then, reducing ΔP_z to make $\Delta P_z=\Delta P_z/2$, z=z+1, repeating steps (1)-(5),

[0069] wherein, 0<ε<1;

[0070] (7) measuring a spectrum of a signal under test under the same settings as in the step (2) by using OSA based on SBS effect, to obtain corrected resolutions corresponding to the sampling points required by calculating OSNR in the spectrum, replacing the setting resolutions with the corrected resolutions to obtain OSNR, which specifically includes the following sub-steps of:

[0071] (7.1) measuring the spectrum of the signal under test which has a central wavelength of λ and a bandwidth of $\Delta\lambda_3$, under the same settings as in the step (2) by using OSA based on SBS effect;

[0072] substituting $P_{Bj}=P_{aj}\cdot\Delta\lambda_1/\Delta\lambda_2$ into the fitting expression of ($Res-P_B$), to obtain the corrected resolutions Res_{aj} corresponding to the sampling points required by calculating OSNR in the spectrum,

[0073] wherein, P_{aj} are power of the sampling points required by calculating OSNR in the spectrum, j=1, 2, . . . , m; $\Delta\lambda_3\leq\Delta\lambda_1$;

[0074] (7.2) obtaining a total power of the signal under test

$$P(\Delta\lambda_3)=\sum_{k=1}^{l}\frac{P_{bk}\cdot\Delta\lambda_2}{Res_{bk}},$$

[0075] wherein, P_{bk} are power of sampling points which fall into the spectrum range having a central wavelength of λ and a bandwidth of $\Delta\lambda_3$, k=1, 2, . . . , l; Res_{bk} are the corrected resolutions corresponding to the power P_{bk} of sampling points;

[0076] (7.3) obtaining a total power of noise: in the case that OSNR is measured by an out-of-band monitoring method, the total power of noise

$$N(\Delta\lambda_3)=\left(\frac{P(\lambda-\Delta\lambda)}{Res(\lambda-\Delta\lambda)}+\frac{P(\lambda+\Delta\lambda)}{Res(\lambda+\Delta\lambda)}\right)\cdot\frac{\Delta\lambda_3}{2},$$

[0077] wherein, P(λ−Δλ) and P(λ+Δλ) are the power of sampling points at wavelengths of λ−Δλ and λ+Δλ, respectively, λ indicates central wavelength; Res(λ−Δλ) and Res(λ+Δλ) are corrected resolutions corresponding to the power P(λ−Δλ) and P(λ+Δλ) of sampling points, respectively;

[0078] (7.4) obtaining optical signal to noise ratio

$$OSNR=10lg\frac{P(\Delta\lambda_3)-N(\Delta\lambda_3)}{N(\Delta\lambda_3)\cdot\lambda_r/\Delta\lambda_3},$$

[0079] wherein, λ_r is a reference bandwidth, and is set to be 0.1 nm.

[0080] It should be appreciated that, for correcting resolution of other kinds of OSA, and for enhancing measuring precision of other OSNR measuring methods based on spectrum analysis, all these methods are included in inventive concept of the present invention.

[0081] While preferred embodiments of the invention have been described above, the invention is not limited to disclosure in these embodiments and the accompanying drawings. Any changes or modifications without departing from the spirit of the invention fall within the scope of the invention.

What is claimed is:

1. A method for enhancing optical signal-to-noise ratio measuring precision by correcting spectral resolution, comprising steps of:

(1) obtaining actual power P_{Ai} of a series of broad spectrum signals which have a central wavelength of λ, a bandwidth of $\Delta\lambda_1$, a power interval of ΔP_z, and a power range of (P_{min}~P_{max}),

wherein, i=1, 2, . . . , n; z=1; P_{min} is the minimal power of broad spectrum signals; P_{max} is the maximum power of broad spectrum signals;

(2) measuring a spectrum of each signal for the series of broad spectrum signals by using OSA, adding up power of sampling points which fall into the spectrum range having a central wavelength of λ, a bandwidth of $\Delta\lambda_1$, to obtain a sum of power of said sampling points, thereby to obtain a series of sums P_{Bi} for the series of broad spectrum signals,

wherein, i=1, 2, . . . , n;

(3) obtaining corrected resolutions $Res_i=P_{Bi}\cdot\Delta\lambda_2/P_{Ai}$ according to said actual power P_{Ai} of the series of broad spectrum signals, said sums P_{Bi} of power of the sampling points, and a wavelength interval $\Delta\lambda_2$ between adjacent sampling points;

(4) obtaining a fitting expression according to said corrected resolutions Res_i and said sums P_{Bi} of power of the sampling points by the least squares method;

(5) obtaining a series of corrected resolutions RES'_i after being fitted according to said series of sums P_{Bi} of power of sampling points and said fitting expression;

obtaining measured power of the series of broad spectrum signals $P'_{Ai}=P_{Bi}\cdot\Delta\lambda_2/RES'_i$ according to the series of corrected resolutions RES'_i after being fitted, said sums P_{Bi} of power of the sampling points, and said wavelength interval $\Delta\lambda_2$;

(6) according to said actual power P_{Ai} and said measured power P'_{Ai} of the broad spectrum signals, obtaining relative errors

$$\left|\frac{P_{Ai}-P'_{Ai}}{P_{Ai}}\right|;$$

and determining whether the following formula

$$\left|\frac{P_{Ai}-P'_{Ai}}{P_{Ai}}\right|<\varepsilon$$

is satisfied;

if yes, performing step (7);

or else, making $\Delta P_z=\Delta P_z/2$, z=z+1, and repeating steps (1)-(5),

wherein, 0<ε<1; and

(7) measuring a spectrum of a signal under test, so as to obtain corrected resolutions corresponding to sampling points required by calculating OSNR in the spectrum; and

obtaining OSNR based on the corrected resolution.

2. The method for enhancing optical signal-to-noise ratio measuring precision by correcting spectral resolution according to claim **1**, in which the step (7) comprises sub-steps of:

(7.1) measuring the spectrum of the signal under test which have a central wavelength of λ and a bandwidth of $\Delta\lambda_3$ by using OSA;

substituting $P_{Bj}=P_{aj}\cdot\Delta\lambda_1/\Delta\lambda_2$ into said fitting expression, to obtain the corrected resolutions Res_{aj} corresponding to the sampling points required by calculating OSNR in the spectrum,

wherein, P_{aj} are the power of the sampling points required by calculating OSNR in the spectrum, j=1, 2, . . . , m, and $\Delta\lambda_3\leq\Delta\lambda_1$;

(7.2) obtaining a total power of said signal under test

$$P(\Delta\lambda_3) = \sum_{k=1}^{l} \frac{P_{bk} \cdot \Delta\lambda_2}{Res_{bk}},$$

wherein, P_{bk} are the power of sampling points which fall into the spectrum range having a central wavelength of λ and a bandwidth of $\Delta\lambda_3$, k=1, 2, . . . , l; Res_{bk} are the corrected resolutions corresponding to the power P_{bk} of sampling points;

(7.3) obtaining a total power of noise

$$N(\Delta\lambda_3) = f\left[\sum_{t=1}^{s} \frac{P_{ct} \cdot \Delta\lambda_2}{Res_{ct}}, \sum_{p=1}^{q} \frac{P_{dp} \cdot \Delta\lambda_2}{Res_{dp}}\right],$$

wherein, P_{ct} and P_{dp} are the power of sampling points, t=1, 2, . . . , s, p=1, 2, . . . , q; and Res_{ct} and Res_{dp} are corrected resolutions corresponding to said power P_{ct} and P_{dp} of sampling points, respectively;

(7.4) obtaining optical signal to noise ratio

$$OSNR = 10lg\frac{P(\Delta\lambda_3) - N(\Delta\lambda_3)}{N(\Delta\lambda_3) \cdot \lambda_r / \Delta\lambda_3}$$

according to said total power of said signal under test and said total power of noise, wherein, λ_r is a reference bandwidth.

3. A method for enhancing optical signal-to-noise ratio measuring precision by correcting spectral resolution, comprising steps of:

(1) obtaining actual power P_A of a broad spectrum signal which has a central wavelength of λ and a bandwidth of $\Delta\lambda_1$;

(2) measuring a spectrum of said broad spectrum signal by using volume grating OSA, adding up the power of sampling points which fall into the spectrum range having a central wavelength of λ and a bandwidth of $\Delta\lambda_1$, to obtain a sum P_B of the power of said sampling points;

(3) obtaining a corrected resolution $Res = P_B \cdot \Delta\lambda_2 / P_A$, according to said actual power P_A of said broad spectrum signal, said sum P_B of the power of said sampling points, and a wavelength interval $\Delta\lambda_2$ between adjacent sampling points;

(4) measuring a spectrum of a signal under test by using volume grating OSA, and obtaining OSNR based on said corrected resolution.

4. The method for enhancing optical signal-to-noise ratio measuring precision by correcting spectral resolution according to claim **3**, in which the step (4) comprises sub-steps of:

(4.1) measuring the spectrum of said signal under test which has a central wavelength of λ and a bandwidth of $\Delta\lambda_3$ by using volume grating OSA, wherein, $\Delta\lambda_3 \le \Delta\lambda_1$;

(4.2) obtaining a total power of said signal under test

$$P(\Delta\lambda_3) = \sum_{k=1}^{l} \frac{P_k \cdot \Delta\lambda_2}{Res},$$

wherein, P_k are the power of sampling points which fall into the spectrum range having a central wavelength of λ and a bandwidth of $\Delta\lambda_3$, k=1, 2, . . . , l;

(4.3) obtaining a total power of noise

$$N(\Delta\lambda_3) = \left(\frac{P(\lambda - \Delta\lambda)}{Res} + \frac{P(\lambda + \Delta\lambda)}{Res}\right) \cdot \frac{\Delta\lambda_3}{2},$$

wherein, $P(\lambda - \Delta\lambda)$ and $P(\lambda + \Delta\lambda)$ are the power of sampling points at wavelengths of $\lambda - \Delta\lambda$ and $\lambda + \Delta\lambda$, respectively, wherein, λ indicates central wavelength;

(4.4) obtaining optical signal to noise ratio

$$OSNR = 10lg\frac{P(\Delta\lambda_3) - N(\Delta\lambda_3)}{N(\Delta\lambda_3) \cdot \lambda_r / \Delta\lambda_3},$$

wherein, λ_r is a reference bandwidth.

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