CANDIDATE'S ANSWER

DESCRIPTION

FORCE SENSOR

TECHNICAL FIELD

The invention relates to a force sensor for detecting forces applied at multiple locations.

BACKGROUND ART

A known force sensor is described in D1, on which the two-part form of appended claim 1 is based.

D1 discloses a force sensor in which an input optical fibre overlaps an output optical fibre at a coupling location. Both fibres are embedded into an elastic transparent material, so that a force applied at the location in the direction of the arrow A brings the fibres closer to each other. When the distance between both fibres is reduced, an optical signal injected by a LED into the input fibre is coupled from the input fibre into the output fibre. A photo-detector receives the coupled optical signal and converts it into an electrical signal. As the intensity of the electrical signal increases with the magnitude of the force applied at the coupling location, the magnitude of the force can be determined.

In order to detect forces simultaneously applied at multiple locations, the force sensor applies the principle above at said coupling locations. The sensor has input fibres and output fibres defining a 3x3 matrix of locations. Each LED injects a continuous optical signal into three input fibres. Each photo-detector is arranged to receive from an output fibre a coupled optical signal. By providing as many photo-detectors as coupling locations, forces applied at different coupling locations can be detected independently.

D1 has the disadvantage that an input fiber, an output fiber and a photo-detector must be provided for each coupling location in order to determine the

coupling locations at which a force is applied. Therefore the force sensor of D1 requires many components arranged in a complex way. This results in high manufacturing costs and a less reliable force sensor as the probability of a component becoming faulty is higher.

Therefore there is a need to solve the problem of how to provide a force sensor for detecting forces applied at multiple locations which requires less components and which is less complex.

SUMMARY OF THE INVENTION

The invention is defined by the appended claims.

Claim 1 is novel over D1 because claim 1 defines a processing unit configured to determine at least one characteristic, which distinguishes the optical signals injected into the input optical fibers, of detected coupled optical signals from the output optical fibers, so as to determine the coupling locations at which a force is applied.

This distinguishing feature of the invention solves the problem of providing a force sensor for detecting forces applied at multiple locations which requires less components and which is less complex by using characteristics of the optical signals to determine which input fiber a detected coupling signal originates from. This means that means of detecting coupled optical signals only need to be provided for each output fiber as opposed to each coupling location. Thus in a system of n input fibers and m output fibers, m output optical signals need to be detected as opposed to n x m output optical signals.

CLAIMS

1. A force sensor for detecting forces applied at multiple locations, the force sensor comprising:

a plurality of input optical fibers (1a, 1b, 1c, 1d);

at least one output optical fiber (2a, 2b, 2c, 2D), each output optical fiber (2a, 2b, 2c, 2D) arranged to overlap each input optical fiber (1a, 1b, 1c, 1d) at a respective coupling location (3) where light can be coupled from the respective input optical fiber (1a, 1b, 1c, 1d) into the respective output optical fiber (2a, 2b, 2c, 2D) upon application of a force;

a light injecting device (5) configured to inject an optical signal into each input optical fiber (1a, 1b, 1c, 1d) wherein at least two optical signals have at least one different characteristic which allows the at least two optical signals to be distinguished from each other;

a light receiving device (6) arranged to detect independently a coupled optical signal from each output optical fiber (2a, 2b, 2c, 2d);

characterised in that:

the light receiving device (16) comprises a processing unit (18) configured to determine at least one characteristic of the detected coupled optical signals, corresponding to at least one of the characteristics distinguishing the optical signals injected into the input optical fibers (1a, 1b, 1c,1d), so as to determine a coupling location at which a force is applied.

2. The force sensor of claim 1, wherein at least one of the different characteristics is a different pulse frequency.

3. The force sensor of claim 2, wherein the light injecting device (5) comprises a light source and a control unit configured to turn the light source on and off at a particular frequency.

4. The force sensor of claim 2 or 3, wherein the light injecting device (5) comprises a shutter with a moveable element which allows or blocks passage of light from a light source into an input fiber, and a control unit configured to open and close the shutter at a particular frequency.

5. The force sensor of any previous claim, wherein at least one of the different characteristics is a different colour.

6. The force sensor of claim 5, wherein the light injecting device (5) comprises at least two light sources (L1, L2, L3) emitting different coloured lights.

7. The force sensor of claim 5 or 6, wherein the light injecting device (5) comprises at least one light source and at least one colour filter.

8. The force sensor of any previous claim, wherein the light receiving device (6) comprises at least one photo-diode (PD1-PD6) for detecting a coupled optical signal.

9. The force sensor of any previous claim, wherein the light receiving device (6) comprises at least one camera (9) for detecting a coupled optical signal.

10. The force sensor of any previous claim, wherein the processing unit (8) is further configured to determine a magnitude of the detected coupled optical signal to determine the size of the applied force.

11. The force sensor of any previous claim, wherein the input optical fibers (1a-1d) and output optical fibers (2a-2d) are attached to opposite surfaces of a transparent elastic sheet.

12. The force sensor of any of claims 1 to 10, wherein the input optical fibers (1a-1d) and the output optical fibers (2a-2d) are separated at a coupling location by a cavity.

13. The force sensor of any previous claim, wherein one of the input fibers (1a-1d) or output fibers (1a-1d) are curved so that at a coupling location (3) the input fiber and output fiber are parallel.

14. A mattress comprising the force sensor of any previous claim.

15. A floor mat comprising the force sensor of any of claims 1 to 13.

Examination Committee I: Paper A EM 2015 - Marking Details			Candidate No	
Category		Maximum possible	Marks awarded	
			Marker 928	Marker 949
	Independent claim	50	47	47
	Dependent claims	35	30	32
	Description	15	11	13
Total			**88**	**92**

Examination Committee I agrees on 90 points and recommends the grade PASS