

Spotfinder

Adaptive Fokuslagenkorrektur fasergebundener Laser-Remote-Scanner mit Linsenoptiken für hohe Laserleistungen Georg Cerwenka

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dieses buch umfasst die erforschung und entwicklung einer prozessbegleitenden adaptiven softwarebasierten und flexibel für laser remote scanner anpassbaren korrekturmethode und eines sensorkonzepts zur stabilisierung der soll prozessfokusslage im interpolationstakt der scannersteuerung und damit der einhaltung des vorgegebenen laserstrahldurchmessers und der prozessrelevanten intensitätsverteilung an der wirkstelle bei der lasermaterialbearbeitung wie dem laserstrahlschneiden schweißen und abtragen sowie dem selektiven laserstrahlschmelzen 3d druck die mit dieser arbeit entwickelte korrekturmethode zur fokuslagenstabilisierung ist vorzugsweise für fasergebundene laser remote scanner mit linsenoptiken für hohe laserleistungen ausgelegt und bietet den anwendern c codierte korrekturalgorithmen die in die scannersteuerung implementierbar sind und die das mit dieser arbeit entwickelte abcd fokusmodell zur verbesserten einstellung der soll prozessfokusslage gegenüber linearen fokusmodellen sowie die matrizenoptik raytracing und pid regelkreisbasierte aktive korrektur des fokus shifts beinhalten die mit dieser arbeit entwickelte korrekturmethode zur fokuslagenstabilisierung wurde am beispiel des vorgegebenen und an der technischen universität hamburg harburg tuhh am institut für laser und anlagensystemtechnik ilas entstandenen 30 kw laser remote scannersystems dragon zur Überprüfung der wirkung eingesetzt und simulativ erprobt in der umsetzung wurden passive und aktive analyse und korrekturmethode des fokus shifts recherchiert ihre eignung für das 30 kw laser remote scannersystem dragon analysiert und bewertet und die ergebnisse tabellarisch aufgeführt weiterhin wurden die zusammenhänge der herausgearbeiteten problemstellungen zur erfüllung der daraus festgelegten zielstellung mit den abgeleiteten teilzielen erforscht dazu wurden der einfluss

der thermischen linse und der umgebungsgrößen auf den fokus shift untersucht außerdem wurden die zur thermischen linse führenden thermischen effekte thermo optischer effekt spannungs optischer effekt end effekt beschrieben und die mathematische modellbildung der thermischen linse auf der basis der finite elemente methode fem umgesetzt zusätzlich wurden eine sensorintegration und eine mathematische modellbildung der brechzahl der luft durchgeführt um die prozessbegleitend gemessenen umgebungsgrößen zur direkten anpassung der korrekturalgorithmen zu erfassen und in die korrekturmethode zur fokuslagenstabilisierung einzubinden abschließend wurde auf der basis der matrizenoptik abcd matrizen die möglichkeit geschaffen das optische gesamtsystem mathematisch und kompakt zu beschreiben und somit die computergestützte berechnung zu beschleunigen im ergebnis der erforschung und entwicklung können mit dem mit dieser arbeit entwickelten abcd fokusmodell die einstellung der soll prozessfokuslage des 30 kw laser remote scannersystems dragon bis zu einer größenordnung gegenüber dem bislang genutzten linearen fokusmodell verbessert und der fokus shift aktiv durch die erweiterung mit einem zeitdiskreten pid regelkreis minimiert die soll prozessfokuslage im interpolationstakt der scannersteuerung stabilisiert und damit der vorgegebene laserstrahldurchmesser und die prozessrelevante intensitätsverteilung an der wirkstelle wirkungsvoll eingehalten werden die zielgruppe sind lasersystemtechnikentwickler hersteller und integratoren anwender in der lasermaterialbearbeitung sowie wissenschaftlich und technisch interessierte

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