Sítios Controlados e sua utilização em geofísica forense com GPR: Uma Revisão Sistemática da Literatura

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Abstract

Research in the field of forensic geophysics with the use of ground-penetrating radar (GPR) has the potential to non-destructively detect buried or hidden targets. It is common to build test areas (controlled sites) to measure the ability to use GPR. Since there are no protocols for the clandestine burial of human bodies, the construction of controlled sites has a great diversity of geometric configurations, types of targets, depth of targets, types of soil, etc. The systematic review of the literature is a bibliographic technique that proposes to answer a question objectively and impartially, evaluating a set of data from a set of scientific articles and other scientific documents (dissertations and theses). For that, systematic methods are defined and used in the identification and selection of articles. After the selection, the analysis and extraction of the information are carried out according to previously defined criteria that allow the selection of the articles with more adherence to the researched theme. And the question posed in this review was to know what are the characteristics of the controlled sites used in forensic geophysics, the parameters of data acquisition in these places, and, consequently, where the research on this theme is going. By analyzing the results, it can be seen that the scientific research developed on the subject is concentrated in the period 2000-2020 with constant growth. The targets most used for research were swine due to the anatomical similarity to humans. As new scopes of investigation are the comparison of characteristics of GPR images for multiple burial scenarios and evaluation of the change in the geophysical response of clandestine graves simulated over the years.

A Revisão Sistemática da Literatura (RSL) é passível de ser auditada, usa métodos sistemáticos para identificar, selecionar e avaliar criticamente estudos relevantes sobre um tema. Tem o objetivo de reduzir vieses das revisões tradicionais (Haligan, 2005).

Utilizou-se o *software* StArt (Lapes/UFScar) na execução da revisão onde os artigos científicos foram encontrados em três bases de dados: Science Direct, Web of Science e Scopus com palavras-chaves compostas por: "GPR" ou "*ground penetrating radar*" e "*forensic*".

Foram encontrados 30 artigos que utilizaram sítios controlados no uso do GPR aplicado a geofísica forense. As publicações ocorreram entre os anos de 2000 e 2020.

Os alvos analisados nos artigos em sua grande maioria foram de suínos, que estiveram presentes em 73,3% dos sítios controlados, mas também se observou utilização de cangurus, restos humanos, objetos como barris metálicos, garrafas d'água, roupas e itens pessoais, simulacro de espingarda e pistola, celulares e cartuchos de munição, tubo de ferro, granadas, tijolos, esqueleto humano de resina plástica e manequins de fibra de vidro. As profundidades estudadas variaram entre 0,15 m representando as sepulturas rasas até 1,2 m representando as sepulturas profundas. A maioria, 60% optou por trabalhar com alvos em apenas uma profundidade.

As frequências centrais utilizadas variaram entre 110MHz e 1200MHz. As frequências mais utilizadas foram 500MHz e 900 MHz, ambas empregadas em 40% dos sítios controlados. A frequência de 500MHz apareceu mais frequentemente associada a solos arenosos enquanto a frequência de 900MHz esteve mais frequentemente associada a solos argilosos e arenoso-argilosos.

Dos 30 artigos analisados, em 53,3% a opção foi de utilizar apenas o GPR para análises de alvo. Nos 46,7% restantes o GPR apareceu associado a outras técnicas geofísicas como eletrorresistividade (Pringle et al, 2020; Cavalcanti et al, 2018; Molina et al, 2016; Pringle et al, 2016; Hansen et al, 2013; Pringle et al, 2012; Pringle

et al, 2008; Powell, 2004), suscetibilidade magnética (Molina et al, 2016; Hansen et al, 2013; Pringle et al, 2012; Pringle et al, 2008), tomografia de micro-ondas (Almeida et al, 2014), varredura a laser terrestre (González-Jorge et al, 2012) e gradiometria magnética (Hansen et al, 2013; Pringle et al, 2008).

A partir da análise dos resultados desta RSL conclui-se que as pesquisas em Sítios Controlados e sua utilização em geofísica forense com GPR estão buscando ressaltar a capacidade do método em identificar alvos em cenários de sepultamento clandestino e entender suas limitações. A frequência de 500MHz, uma das mais utilizadas, trouxe melhores resultados no acompanhamento da evolução da decomposição com uma relação de resolução e profundidade satisfatória. Com essa RSL também foi possível constatar que as pesquisas estão sendo direcionadas para comparação de frequências, aplicabilidade do GPR, demonstração da eficácia do método e estabelecimento de um protocolo de uso de GPR como método indireto preferencial a ser utilizados no início de uma investigação forense que envolva a busca por restos mortais.

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